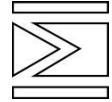


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General Information

It is not allowed to copy this operating manual anyway or to circulate information to misuse in competition.

Disregarding obliges to compensation.
All rights reserved.

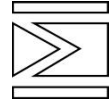
Information of use

We are free to change the construction and technical data due to further development.

Because of this it is impossible to make demands out of images, details or descriptions.
Errors excepted!

Read the safety information in chapter 2 carefully and the signed remarks in the manual.
Disregarding the safety information may involve violations/injuries including death and property damage which could be greater than losing the welding machine.

Please read the manual to get vital information about your system. Familiarize yourself with the system. You are encouraged to spend as much time as possible reviewing the system components before your Sigma-Laser GmbH service engineer arrives for the installation and training.

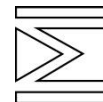


1 Product description

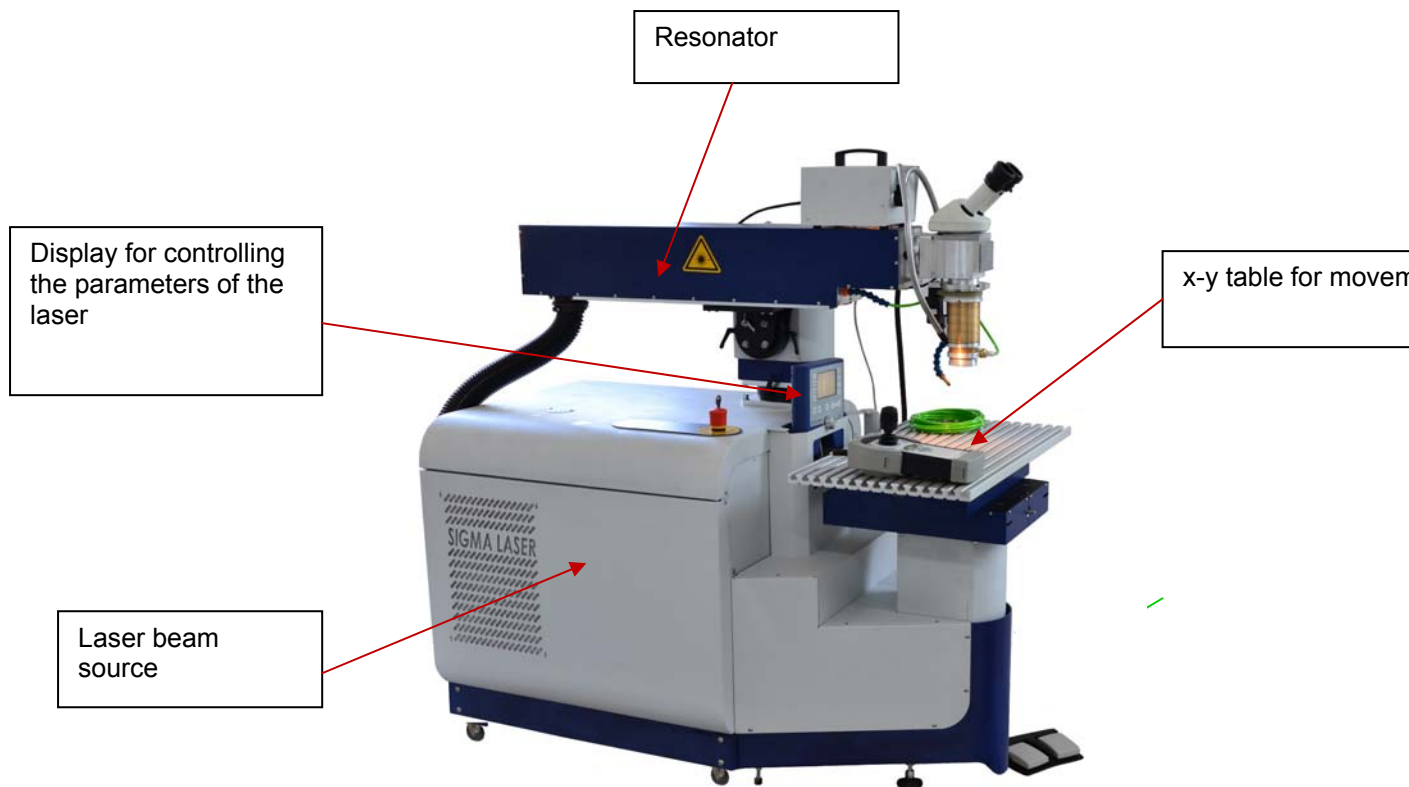
The stationary laser welding system SL120 / 160 are for welding and repair of precision parts made of aluminum, steel, copper, titanium, and chrome-nickel alloys using laser deposition welding. Our own patented auxiliary materials are specially adapted to precision form construction. The laser micro-processing can be performed on points micrometers in size and therefore be performed without strains, cracks, delays/defaults, or undercuts. It is also possible to restore graphite electrodes.



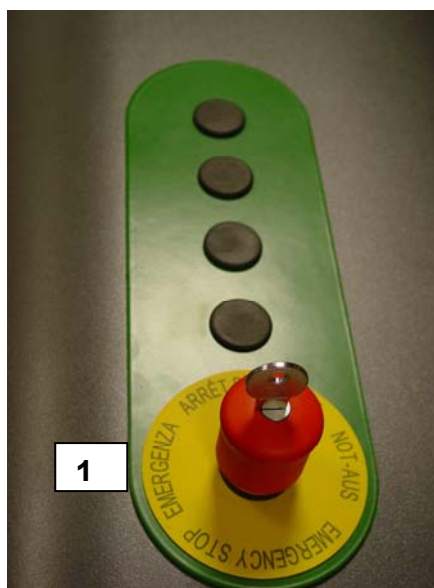
If the stationary laser welding system SL120 / 160 is not used as specified, operation of the laser equipment cannot be ensured. The operator, and not the manufacturer, of the laser processing station is liable for all damage to persons and property that arise from use other than the specified one.



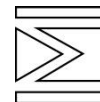
Construction and function



Picture 1



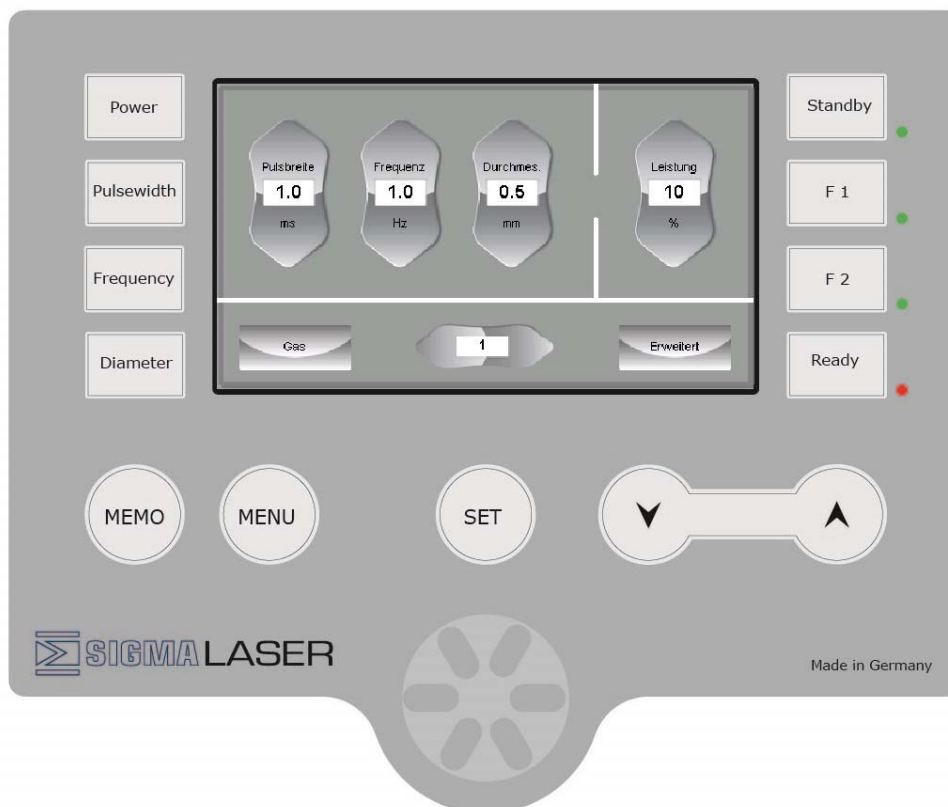
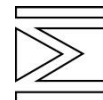
Picture 2



Picture 3

Table 1

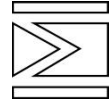
| It. | Description |
|-----|--|
| 1 | Emergency stop button |
| 2 | Switch for the power supply |
| 3 | Connection for the pedal - 7-Pin-Plug |
| 4 | Connection for the safety-set (door switch and signal lamp) – 5-Pin-Plug |
| 5 | Current supply |



Picture 4: Laser beam display; laser parameter adjustment

| Name | Description |
|--------------------|---|
| Standby | Device ready for operation, Laser shutter closed |
| Ready | Laser emission possible by actuating the pedal |
| Menu | For switching the Cursor between the parameters |
| Set | For saving the parameters |
| Memo | Selection of saved parameter sets between 1 and 50 |
| Gas | Switch-on of the gas feed valve |
| Pulse Width | Pulse length, in ms (milliseconds) – adjustable between 0,5 and 20 ms |
| Frequency | Pulse frequency in Hz – adjustable between 0,5 and 20 Hz/40Hz |
| Power | Regulation of laser output power (declaration in volts) |
| Diameter | Setting for the focal diameter – adjustable between 0,2 and 2,0 mm |
| F1 | not in use |
| F2 | not in use |

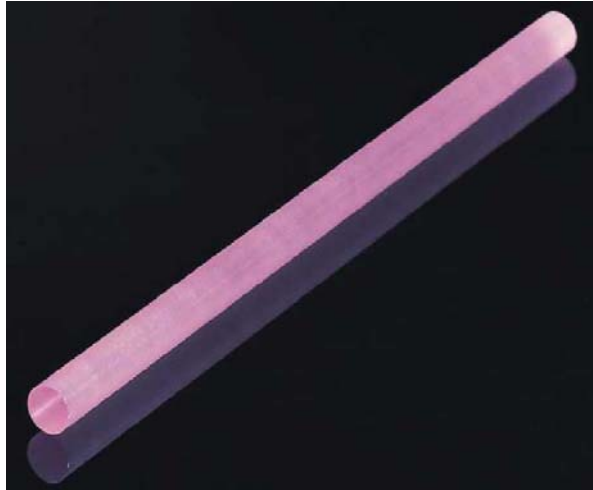
Table 2



Principals of laser beam generation

The word "laser" is an acronym for **L**ight **A**mplification by **S**timulated **E**mission of **R**adiation.

Not all lasers are emitting light in the visible range (electromagnetic radiation between 400nm and 750nm wavelength) although they are sometimes described as light source and the radiation called laser - light.

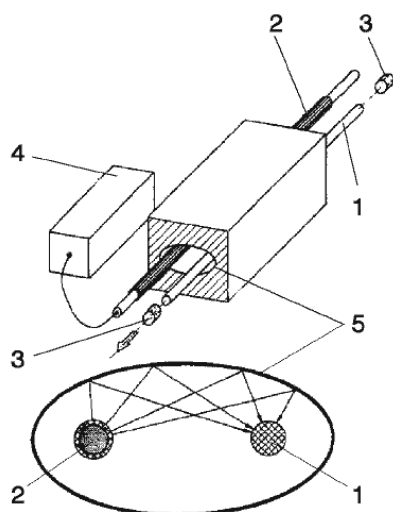
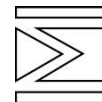


Laser crystal

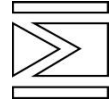
The laser which is used in the Mobile Welder is an Nd:YAG solid state laser emitting light of 1064nm wavelength (**N**ear **I**nfra**R**ed).

Nd-YAG means **N**eodymium - **y**ttrium **a**luminum **g**arnet crystal. This crystal is used as laser medium.

If the crystal is in the longitudinal direction between the mirrors (3) that form the physical resonator, that part of the radiation that is reflected through the mirrors by the crystal is amplified when it goes through the crystal. Above a certain threshold, the population inversion level, laser radiation occurs during the stimulated emission, i.e. amplified light for which the wavelength, direction, phase length, and polarization correspond.



- | | |
|---------------------|------------------------------|
| 1 laser crystal | 4 lamp supply |
| 2 lamp | 5 mirrored elliptical cavity |
| 3 resonator mirrors | |



The wavelength-specific reflection of the resonator mirrors selects the required wavelength from the wavelengths generated by the laser crystal. That part of the laser radiation that is available for use is emitted via partially transmitting mirrors.

It is possible to reach out 10 Megawatts on optical output with a pulsed Nd:YAG laser system. But it is impossible to reach out with only one crystal, because every crystal is designed for a maximum output and would be destroyed by overloading.

It could be reached by packing several cavities in a line between the mirrors.

The resonator module contains the pump flash, the laser crystal and cavity that form the stimulation unit, and the resonator mirrors, as well as other elements that are required for operation of the laser, or that make it possible to practically apply the laser radiation.

The optical components at both ends of the laser crystal are mounted stably and adjustably in the adjustment holders to securely create the optimal geometrical requirements for the generation and forming of the laser radiation.

The dust-tight and water-resistant housing ensures protection of the optical components and eliminates mechanical and thermal influences on the precise adjustment of the resonator components.

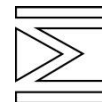
A safety shutter behind the partially transmitting mirror prevents uncontrolled emission of the laser radiation. An illuminated LED indicates the open position.

The resonator housing contains the connection for igniting the pump flash.

The resonator housing could be moved in x – y – z direction by a motorized movement for an individual working position.

90° beam deflection and stereo microscope

Deflecting the laser beam downwards by 90° allows convenient and secure application of the focused laser beam on the hand-guided work piece. The effect is controlled visually using the stereo microscope. A protective filter in the beam passage prevents Nd:YAG laser radiation from entering the eyes through the observation beam passage. An additional LCD shutter that is switched to block light for the duration of each laser pulse protects against blinding from the bright secondary radiation arising during welding.



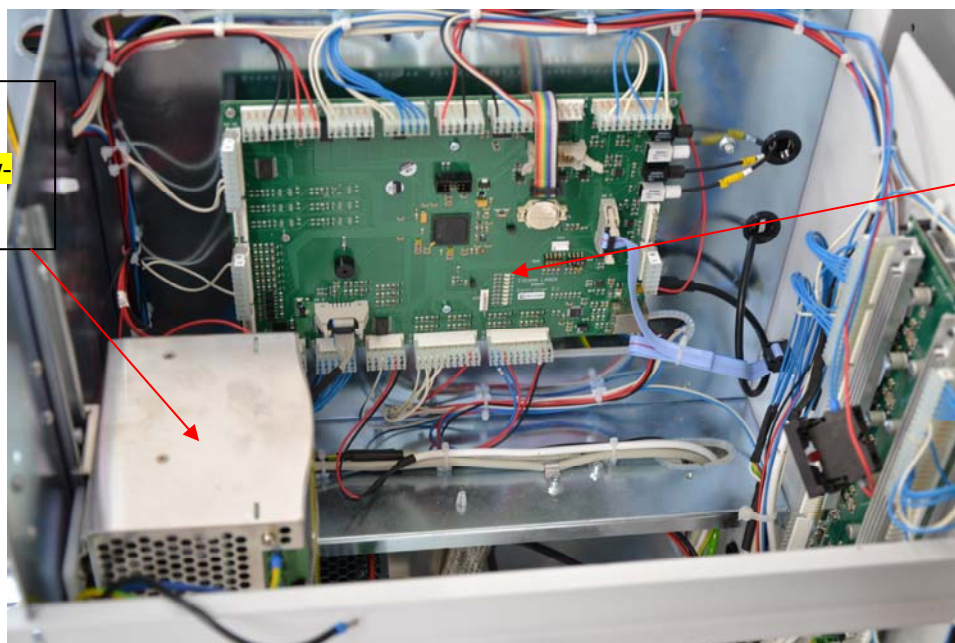
Network power supply

The network power supply on the inlet side contains all necessary components for safe connection to the power supply network such as network separation switch, main contactor, network fuse protection and distribution, as well a motor protection switch for the coolant pump or a further overload cut-out for water/air cooling system.

On the output side, the integrated power unit provides the necessary power for the pump flash, which can be set in a suitable form, as well as the booster voltage required to ignite the pump flash.

24-Volt-supply:

Power supply for all low-voltage devices

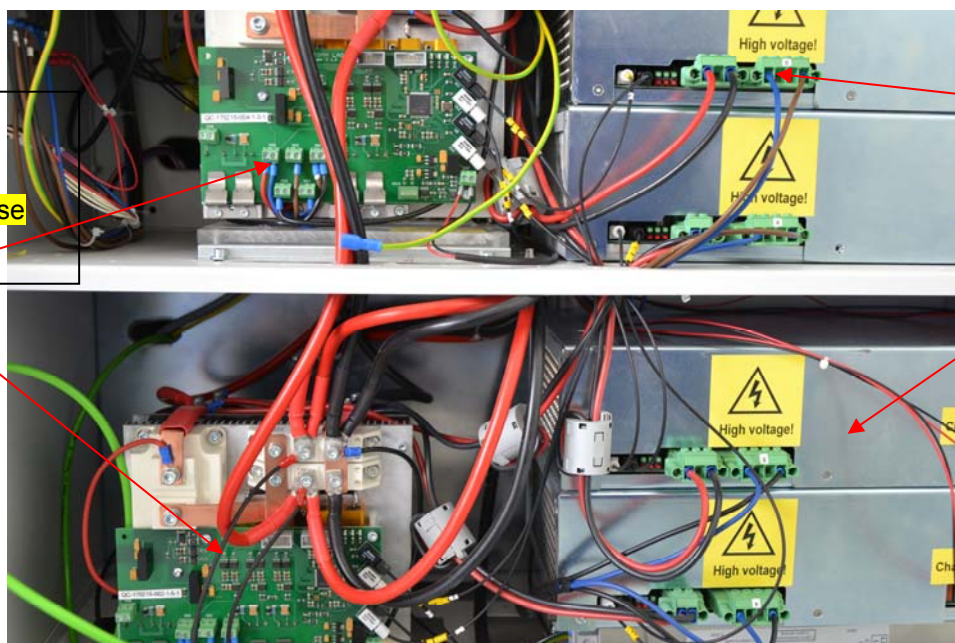


Controller for the laser beam source:

- Controlling the electrical parameters
- Memory location for parameters
- Monitoring functions

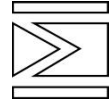
Discharge-electronic:

Connection to the flash lamps to control the pulse energy



Charger 1,2 and 3

For charging the capacitors with electrical energy

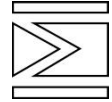


Internal cooling system with water/air heat exchanger

The cooling system provides coolant to transport the power loss out of the resonator.

The closed cooling circuit contains **deionizer water** as the coolant. It is supplied via a pump from the reservoir through parts of the resonator, the heat exchanger, the particle filter, and partially through the deionization filter, and back to the reservoir.

The level, temperature, and flow volume/flow rate switches the functions of the cooling system.



General Safety Information

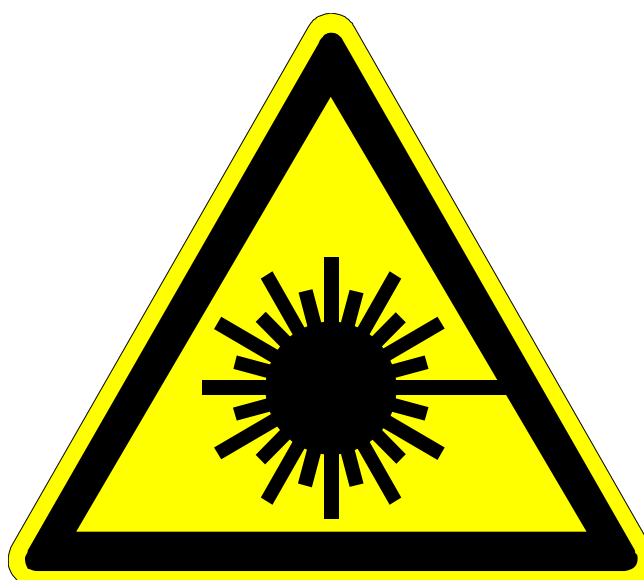
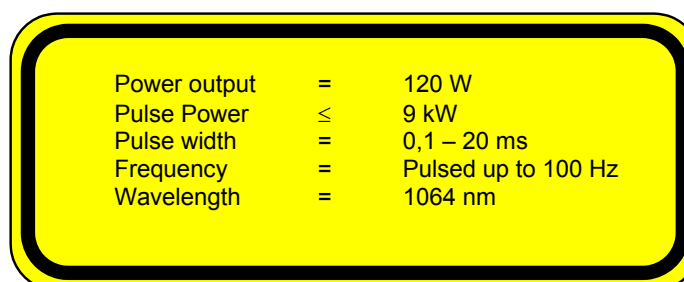
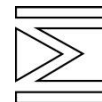
Due diligence of the operator

The laser welding machine **MW 120/160** was designed and built under consideration of a risk analysis and after careful selection of the harmonized norms and other technical specifications to be complied with. It complies with the requirements of directive DIN EN 60825-1/11.2001 (VDE 0837 chapter 1) "Safety of laser equipment". The invisible laser radiation used for deposition welding presents a danger to the eyes and skin, which is the reason the device is classified as a **Class 4** laser.

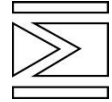
The necessary safety of the operator and others can only be achieved in operational practice if all the measures necessary for this have been taken. The obligation to diligence of the operator of the laser processing station requires the operator to plan these measures and to monitor their implementation.

In particular, the operator must ensure that:

- operation of the laser processing station has been reported to the responsible supervisory authorities for workplace protection and the professional association (for details, see 2.8).
- a laser protection officer with the necessary special knowledge is appointed in writing (for details, see 2.8). Please refer to the regulations in your country.
- the laser processing station is only used as specified (see Section 1.1 "Specified use") and with extreme care. In particular, unsupervised operation is not permitted.
- the laser processing station is only operated in flawless, functional condition, and that the safety equipment in particular is checked regularly for functionality (see Chapter 8 "Maintenance").
- the laser area is cordoned off as specified and marked (see above).
- the necessary protective equipment (especially norm-compliant laser protection glasses) is issued to and used by the operation, maintenance, and repair personnel.
- The instruction manual is constantly available in complete and readable condition at the site of the laser processing station and can be viewed there by the operators.
- only sufficiently qualified and authorized personnel operate, maintain, and repair the laser processing station. The training courses provided by O.R., which give instruction in the correct and safe use of deposition welding, serve this purpose.
- this personnel is regularly (i.e. at least once a year) trained in all applicable questions of laser safety, general operational safety, and environmental protection and knows the operating manual and the safety information contained in it.
- all laser warning signs and symbols attached to the laser processing station are not removed and remain in readable condition






Warning symbols and instruction signs

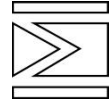


Explanation of the safety symbols used

The following safety symbols are used in this instruction manual. These symbols are intended to bring the reader's attention to the safety information next to them.

| | |
|---|--|
|  Danger | <p>This symbol indicates that dangers to the life and health of people exist.</p> |
|  Caution | <p>This symbol indicates that dangers to equipment, material, or the environment exist.</p> |
|  Note | <p>This symbol does not indicate safety information, but rather information that gives a better understanding of device functions and properties.</p> |

The symbol used cannot replace the text of the safety information. The text must therefore always be read completely.



Basic safety measures for normal operation and maintenance

For all work with and on the laser processing station:

- The accident prevention directive BGV A 1 "General regulations" must be observed.
- The accident prevention directive BGV B 2 "Laser radiation" must be observed.
- For all work on the electrical equipment, the accident prevention directive BGV A 2 "Electrical equipment and operating materials" must be observed.
- The instruction of the operating manual must be carefully observed.
- The laser beam must never be directed at people or animals.
- It must be ensured that every person involved in the operation, maintenance, and repair of the laser equipment has read and understood the operating manual and the safety information for the laser equipment.


For all work with the beam passage open:

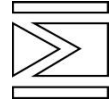
- There is a danger of burning the eyes and skin.
- Wear suitable laser protection glasses.
- Never look into the laser emission opening - even with the laser switched off.
- Never hold tools or metal parts with reflective surfaces in the laser beam passage.
- Cordon off the laser area using non-flammable, non-reflective, firmly-installed separation walls those prevent any view of the laser beam passage.
- Optical elements must always be firmly screwed in - danger of laser beam changing direction due to unintentional movement or positional change of these parts.

For all work on the pump flash:

- There is a danger of explosion of the highly pressurized pump flash.
- The pump flash must be handled with extreme care.
- Wear full face protection to protect from injury by glass shards.
- Wear sturdy gloves to protect from injury by glass shards.


For detailed safety information for the individual maintenance tasks, see Chapter 8 "Maintenance".

| | |
|--|--|
|  <p>Danger</p> | <p>If operating and adjustment equipment other than that described in these instruction is used or if other procedures are applied, it can lead to dangerous exposure to radiation.</p> |
|--|--|



Danger to the eyes and skin


This laser device is an Nd:YAG solid-state laser of laser class 4. It emits a very high radiation power. This radiation in the near infrared range with a wavelength of 1064 nm is invisible.

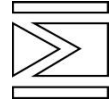
| | |
|--|--|
|  <p>Danger</p> | <p>Danger exists from:</p> <ul style="list-style-type: none"> - The direct laser beam - Reflected laser radiation - Diffusely scattered laser radiation |
|--|--|

The eyes are at particular risk from this invisible laser radiation, because the high radiation power is bundled further by the lens of the eye and focused on the retina. The high radiation strength on the retina causes local heating and burning of the retinal tissue with damage that can range from unnoticeable reduction to complete loss of the ability to see. The radiation of this device can be dangerous to the eye even when unnoticed and from a substantial distance.


The protective glasses offer protection against the direct beam, reflected, and diffusely scattered radiation. Looking directly into the laser emission opening even with protective glasses must still be absolutely avoided, because the intense radiation of the laser may not be held back due to damage or may damage or destroy the protective filter.

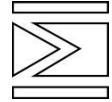
When using protective glasses, ensure that they do not have any flaws, are suitable for the wavelength range (1064 nm), and correspond to the emitted laser power in their protection level (L8). Interchanging glasses due to confusion is dangerous, because the protective effect of the filter only applies to a narrow wavelength range and up to a certain defined power limit. For example, glasses for CO₂ lasers (10.6 µm) do not protect against radiation from Nd:YAG lasers (1064 nm).

| | |
|--|--|
|  <p>Danger</p> | <p>Mark and restrict the laser area in which the laser beam can be accessed (also from reflections, for example)!</p> <p>All persons in the laser area must wear suitable laser protection glasses of protection class I 1064 L8!</p> <p>For all work with the laser housing open:</p> <ul style="list-style-type: none"> - Stop the laser resonator or place an absorber block in the beam passage! - Never look into the laser emission opening - even with the laser switched off! - Never hold tools or metal parts with reflective surfaces in the laser beam passage! |
|--|--|



In comparison to the eyes, the skin can take substantially higher radiation strengths without damage. However, here too, tissue can be damaged or destroyed, depending on the length of exposure and the radiation strength.

| | |
|---|--|
|  | <p>If laser damage is determined or suspected:</p> <ul style="list-style-type: none"> - Switch the laser off immediately. - Secure the laser against unintentional switching back on. - Inform superiors, laser protection officer, plant doctor, and safety personnel |
|---|--|



Danger of fire

In addition to the metal to be welded, the high emission power of the laser processing station can also heat up many other materials so highly that they catch fire.

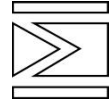
| | |
|--|--|
|  <p>Danger</p> | <p>For all work, remove highly flammable materials from the surroundings of the laser system!</p> |
|--|--|

Combustible objects such as paper, non-flame retardant or non-impregnated curtains, wooden boards, and similar objects can easily ignite from direct or reflected laser radiation.

In particular, containers with easily flammable or explosive solvents or cleaning agents, as well as pressurized gasses must be removed from the area where laser radiation is accessible or screened out using suitable measures. Any contact of laser radiation on these containers can very quickly and easily lead to large fires or explosions.


View although Paragraph 10 and 16 of accident prevention directive BGV B 2 "laser radiation"






Danger from high voltage

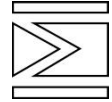
This laser welding machine is designed according to generally recognized rules of engineering. In particular, the applicable EC directives, EN (European norms), and DIN norms and VDE regulations have been complied with.

| | |
|--|--|
|  <p>Danger</p> | <p>Work on electrical components of the laser processing station may only be performed by appropriately trained electricians. These people must also be trained in the dangers of laser radiation.</p> <p>For all work on the electrical equipment, the accident prevention directive BGV A 2 "Electrical equipment and operating materials" must be observed.</p> |
|--|--|

Operating the laser requires high voltages that pose a mortal danger. In particular, work on parts of the supply system for the pump flash requires special caution. The voltages of several kV there, which pose a mortal danger, demand absolute compliance with appropriate air and crawl spaces. Long after the device is switched off, condensers can be loaded with high energies that can lead to deadly electrical shocks.

A second person who has at the least been informed of the dangers of laser radiation and life-threatening high voltage should always be in the immediate vicinity for the duration of the work. In case of emergency, this person can switch the device off and take first aid measures.

| | |
|--|---|
|  <p>Danger</p> | <p>For all work on electrical components, observe the 5 safety rules:</p> <ul style="list-style-type: none"> - Disconnect. - Secure the laser against unintentional switching back on. - Ensure that there is no voltage. - Ground and short-circuit. - Cover or isolate neighboring parts of the system that are under voltage. |
|--|---|




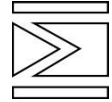
Danger from operating the laser processing station

This laser system is equipped with a series of measures for protection from the dangers of laser radiation and high voltage. If there are damages or defects, laser radiation can be emitted unintentionally, or the laser equipment can damage itself.

During material processing with laser radiation, decomposition products that are dangerous or damaging to health can be released from the processed material. Especially during the processing of plastics and coated or oil-coated metals, vapors and dust that are damaging to health can be emitted. These decomposition products must not be breathed in or taken into the body in any way.

To protect human health and the environment, decomposition products arising during processing must be taken up by sufficiently dimensioned suction systems equipped with special filters.

| | |
|--|---|
|  <p>Danger</p> | <p>For all damages to or defects of the laser equipment, protective devices:</p> <ul style="list-style-type: none"> - Switch the laser off immediately. - Secure the laser against unintentional switching back on. - Repair the defective parts. - Use only replacement parts expressly authorized by the manufacturer. - Check all laser system functions after the repair has been completed. - Check the function of all protective devices and accessories. |
|--|---|



Legal regulations for the operation of laser equipment

The accident prevention regulation BGV B2 "Laser radiation"

According to the accident prevention regulation BGV B2 "Laser radiation", initial commissioning of the laser processing station (as for all other laser equipment of classes 3B and 4) must be reported immediately to the responsible professional association and the authorities responsible for workplace protection (usually the industrial inspectorate). This requirement is fulfilled if the report contains specifications of the manufacturer, laser type (for example impulse laser or continuous beam laser), radiation power, possibly pulse duration and wavelength of the radiation.

The laser safety officer

To operate this class 4 laser equipment, a knowledgeable laser protection officer must be appointed in writing by the company.

The laser protection officer must have sufficient knowledge in the area of laser radiation and protective measures and devices due to his specialized training and experience.

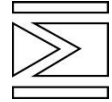
Through the appointment, the company transfers the responsibility for safe operation of the laser equipment and the necessary protective measures to the laser protection officer.

The operating personnel

Only knowledgeable specialist personnel may be used for operating the laser processing station.

The operating personnel must be familiarized with and understand all protective measures and devices as well as the operation of the device.



All people who have access to the laser area, i.e. not only the operating personnel in the strict sense, must be trained regularly in the laser protection measures (at least once a year). The required training contents can be taken from the accident protection directive BGV B2 "Laser radiation". It is recommended that the laser protection officer have all employees confirm their participation in these training courses in writing.



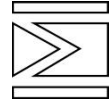
Transport

The Stationary Laser welding machine will be preferably transported as a unit. The laser beam source is attached with the body of the system.

To avoid damage to the device or life-threatening injuries during transport of the laser welding machine SL 120/160, the following points must always be observed:

| | |
|---|--|
|  <p>Danger</p> | <p>The transport work may only be performed by qualified and authorized personnel and in compliance with the safety instructions.</p> <p>Load-bearing and connection equipment must meet the requirements of the accident prevention regulations!</p> <p>The load-bearing and connection equipment must be selected appropriately under consideration of the weight of the processing stand (300 kg)!</p> <p>Locate and fix the swiveling arm with some proper means. It is not enough to pull the arm near the column only!</p> <p>The brackets of the castors are only for a positioning during the treatment on smooth areas. They should not be used as a transport lock!</p> |
|  <p>Caution</p> | <p>Before beginning the installation work, all components of the processing station must be inspected for transport damages.</p> |

See also Chapter 2 "General safety information".




Installation

Because the laser processing station is a class 4 laser device, it must be possible to enclose the laser area so that it is secure against radiation. If it is not a special room with monitored (door contact switch) and marked (warning sign, warning lights), suitable protective curtains or portable walls must be provided.

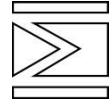
The foundation must be able to carry the weight of the processing stand of 350 kg.

The ambient temperature must be between +5° and 32° C.

| | |
|---|--|
|  Caution | <p>Never allow any negative temperature (0°C)!</p> <p>Danger of frost!</p> <p>Corrosion of optical and electronic components!</p> |
|---|--|



Picture 5: Operating position



Electrical installation

Power for the entire laser processing station is supplied via a single CEE plug.

The socket must be installed according to applicable VDE regulations and be completely connected to a zero conductor and an equipment grounding conductor. The network frequency must be 50/60 Hz. Fuse protection with 20 A is sufficient. The maximum power consumption of the various types:

MW 120: ca.4 kW

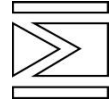
MW 160: ca. 6 KW allocated on 3 phases

MW 220: ca. 8 KW allocated on 3 phases

MW 330: ca. 11 KW allocated on 3 phases (CEE 16 / 3 x 32 A)

MW 420: ca. 15 KW allocated on 3 phases (CEE 16 / 3 x 32 A)

MW 500: ca. 18 KW allocated on 3 phases (CEE 16 / 3 x 32 A)



Commissioning

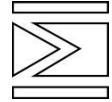
The laser processing station may only be commissioned after the setup and installation work by authorized employees of *Sigma Laser GmbH* has been officially completed.

The operation site must meet all safety requirements for a laser area. Please read absolutely at first the instruction manual before to begin to work with the machine.

See also Chapter 2 "General safety information".

Check the following points before to switch on.

| Components to be checked | Type of check |
|--------------------------|---|
| Electrical connections | Check whether all necessary connections are plugged in and that the plugs are inserted firmly. |
| Electrical connections | Check whether the insulation of all connection cables is undamaged on the outside and ensure that the cables are not subject to pulling strain, and are not crushed or bent more sharply than is permitted! |
| Cooling water circuit | Ensure that all connection hoses and the device housing are dry on the outside! |
| Gas connection | Ensure that all connections are plugged in and that the plugs are inserted firmly and no gas exhaust! |
| Processing stand | Ensure that all transport protection devices have been removed and that all moving parts can move through their entire range of motion without impacting anywhere or causing any other danger! |
| Interlock connection | Ensure that the connection line are plugged and not bridged! |
| Pilot lamps | Ensure that all needed bulbs are put in and working. |



Switching on the laser processing station for the first time

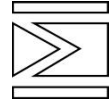
If all checks have been successfully completed and the necessary laser protection measures have been taken, the laser processing station can be switched on

The laser beam source obtains its current supply from main supply of the mobile unit indeed. However, the unit has its own main switch which can be used to switch on or off the laser beam source.

Switching on the station occurs in the following order:

- 1. Main switch** (Table 1 lt.2)

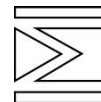
An acoustic signal rings out and the display displays the test run.



Function test of the safety equipment

To avoid damage to the device and injuries to people, all safety equipment must be tested before initial commissioning, before start-up after a long still stand period, and every day before starting work!

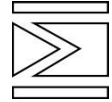
| Safety equipment | Type of check |
|---------------------------------------|--|
| Emergency stop button | Pressing must stop the system immediately. |
| Limit switch for motorized z movement | Laser arm must stop automatically when the upper and lower end points are reached during motion. |
| Limit switch for motorized x movement | Laser arm must stop automatically during motion of the X-axis (long axis) at the both end points |
| Limit switch for motorized y movement | Laser arm must stop automatically during motion of the Y-axis (short axis) at the both end points |
| Interlock | Trying to open the safety circuit must lead to stop the laser system immediately and indicate an alarm message on the display. |



Checks after initial operation

Execute the following checks after the first commissioning:

| Components to be checked | Type of check |
|---------------------------------|--|
| Cooling water circuit | Check whether all connection hoses and the device housing are dry on the outside and whether the water level in the reservoir has changed! |
| Gas connection | Check whether the gas connecting line would be leak proof at the housing! |
| Optical components | Check whether the laser optics, the stereo microscope, or the housing surfaces that enclose the laser radiation have warmed! |



Operating Functions

To avoid damage or life-threatening injuries during operation of the laser processing station, the following points must absolutely be observed:

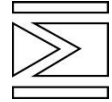
- The laser processing station may only be used as specified.
- Before switching on the laser processing station, inform yourself of the necessary laser protection measures and of the proper behavior during malfunctions.
- Perform functional checks of the safety equipment before using the station for the first time and later in regular intervals:
 - Function of the emergency stop button
 - Function of the limit switch for x- und y-axis
 - Function of the limit switch for motorized z movement of the laser arm and work piece table
 - Flawless condition of the protective filter in the observation beam passage

See also Chapter 2 "General safety information".



Caution

**Operating of the machine only allowed for persons, who have read and understood the instruction manual and the safety information for the machine!
Never use the emergency stop button to shut the machine off!**



Description of the control elements – Controller of the moving axis

The following features are only available in systems that are equipped with a motorized working table or an robotic arm.

This chapter is about the handling with a joystick. The motorized table, the integrated CNC functions and the touch screen options will be described in the next section.

To operate the working table you can use the joystick with the following functions:

Progressive Joystick: The speed will change based on the joystick deflection. At the maximum deflection the system will reach the maximum speed.

Digital Joystick: By pressing the **F4-Button** the joystick will be set in digital mode. With this setting the speed of the axes doesn't depend on the deflection of the joystick anymore. The axes move with the speed that was adjusted with the **V+ Button** before. The speed can be set between 0 and 100% whereby the actual value can be seen on the joystick display.

Jog-Off-Function: The Joystick-Jog can be switched off. The axes could be moved instead with the buttons **<<** and **>>**. This function allows a precise movement without an unintentional movement of the other axes.

Vmax-Function: With this button all axes are moving with max. positioning speed.

Coordinates-Invert-Function: Pressing the F1 button will interchange the x and y axis. This function helps to work with a swivelling optic because in this device the axes the directions are mirror-inverted.

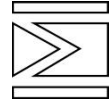
Teach-In-Funktion:

This system is equipped with six automatic programs **as standard**, which can be operated via joystick. For more details refer to chapter „Extras – Automatic functions“

4. axis function: You can activate the fourth axis (c-axis) by pressing the button **Z2**. This can be used to operate a rotary device or a wire feeding system.

Automatic Laser:

By pressing the button **F2** the system can be switched in the „Automatic Laser Modus“. If activated you can recognize the **Symbol „L!“** in the small display of the joystick. From this point every time you move the joystick the laser will be started automatically as well. This function needs to be adjusted in the menu for the axes movement (see next page).



Menu features:

By pressing the menu button the user receives access to the control elements for the axes movement.

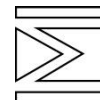
This settings can also be done by using the touch screen.

For scrolling up and down between the different values you can use the buttons ▼▲. Press the buttons ◀▶ to change the actual value.

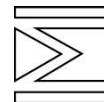
Please bear in mind, that all changes will be saved immediately. To return to the main menu press again on the menu button.

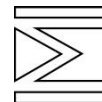
Attention: All changes to the axes speed or acceleration should only be done by technically versed persons.

Wrong settings can result in heavy vibrations of the system.



| Name | Description |
|---------------------------------|--|
| X-axis | Switch on/off the X-axis. |
| Y-axis | Switch on/off the Y-axis. |
| Automatic-Laser (ALO) | Switch on the laser during the joystick movement. Reaktion auf - no axis - XY-axis - Z-axis (Z2-axis) - both |
| Pulssynchronisation (PSync) | Not implemented yet |
| Buttons (Head) | Assignment of the joystick head buttons. - Laser .(Single-/Continuous Pulse) - VMax (right button) - Z3-axis(up/down) - Z4- axis(up/down) - Automatic (right button: next repeat) |
| Max. Speed XY (SpeedXY) | The setting of the speed for the XY-axes are adjusted in percent with regard to this value (stepper motor unit). |
| Max. Speed Z2 (SpeedZ2) | The setting of the speed for the Z2-axis (C-axis) are adjusted in percent with regard to this value (stepper motor unit). |
| Start-up speed | This percentage value is adjustable in the joystick menu after the system power up |
| VMax XY (VMaxXY) | Operational speed (stepper motor units) on the XY-axes if the function VMax is activated. |
| VMax Z (VMaxZ) | Operational speed (stepper motor units) on the Z-axis if the function VMax is activated. |
| Acceleration (Acc) | Acceleration (stepper motor units) for the analogue operation mode. Decrease this value to create a ramp like movement of the joystick |
| Acceleration (Digital) (AccDig) | Acceleration (stepper motor units) for the digital operation mode. Decrease this value to create a ramp like movement of the joystick |



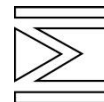


Vmax: All axes move with Vmax.

F1: Pressing this button will interchange the x and y axis

F4: By activating the F4-button the joystick is switched to digital mode. In this setting the axis speed doesn't relate on the deflection of the joystick any more. The speed is shown in the display as a percent value.

F2: by pressing the F2 button the system can be switched in the „Automatic Laser Mode“. The laser starts automatically everytime the joystick is deflected.



Description of the operating elements – Laser beam source

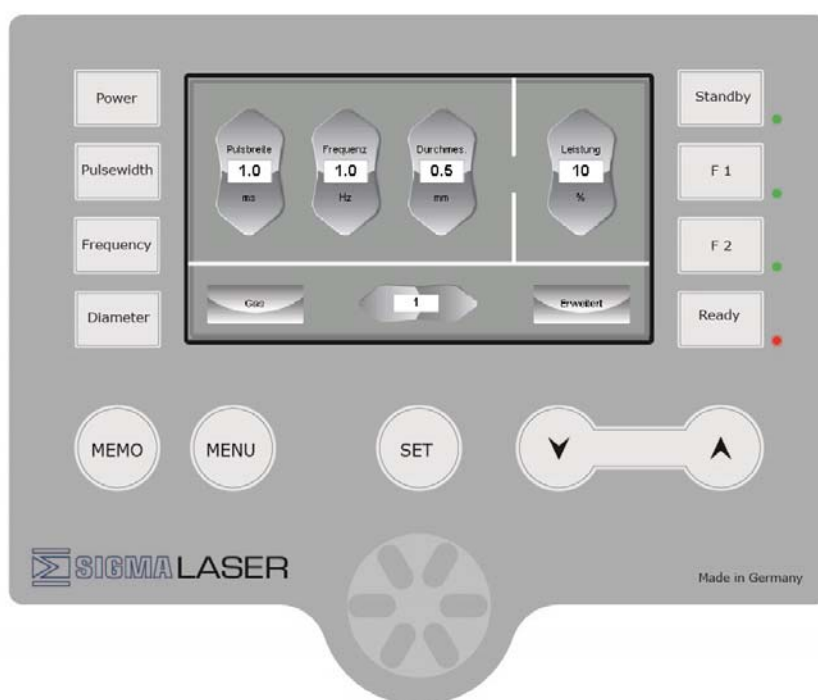
The separable display can be fixed by help of magnetic retainer. The controller only allows a certain number of combinations of parameters and thereby regulating the total power of the laser. At very high power outputs for example, the pulse frequency will be automatically reduced.

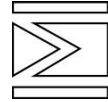
With the display the user gains access to the laser beam operation menu as well as the menu for the axes movement.

Basic Setting

The laser beam source has the ability to operate with two separate pulses. Through phase shifting and overlapping the user can perform a pulse shaping. These pulses are named as main pulse P1 and second pulse P2. For every pulse there is only a specific parameter setting permitted. If the system exceed for example the maximal laser power, the frequency will automatically decrease to prevent damage from the system. You will get more information about the pulse shaping issue in the next chapter.

In the **Basic Setting Menu** (see below) the user can variate the settings for the main pulse (pulse power and pulse width) but also the basic setting of the laser beam source (frequency, focal diameter). This site will be shown directly after switching on the machine and the successful self-test. A change of the parameters can be done by using the touch screen, the Jog-Wheel or the buttons on the site of the display.

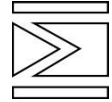




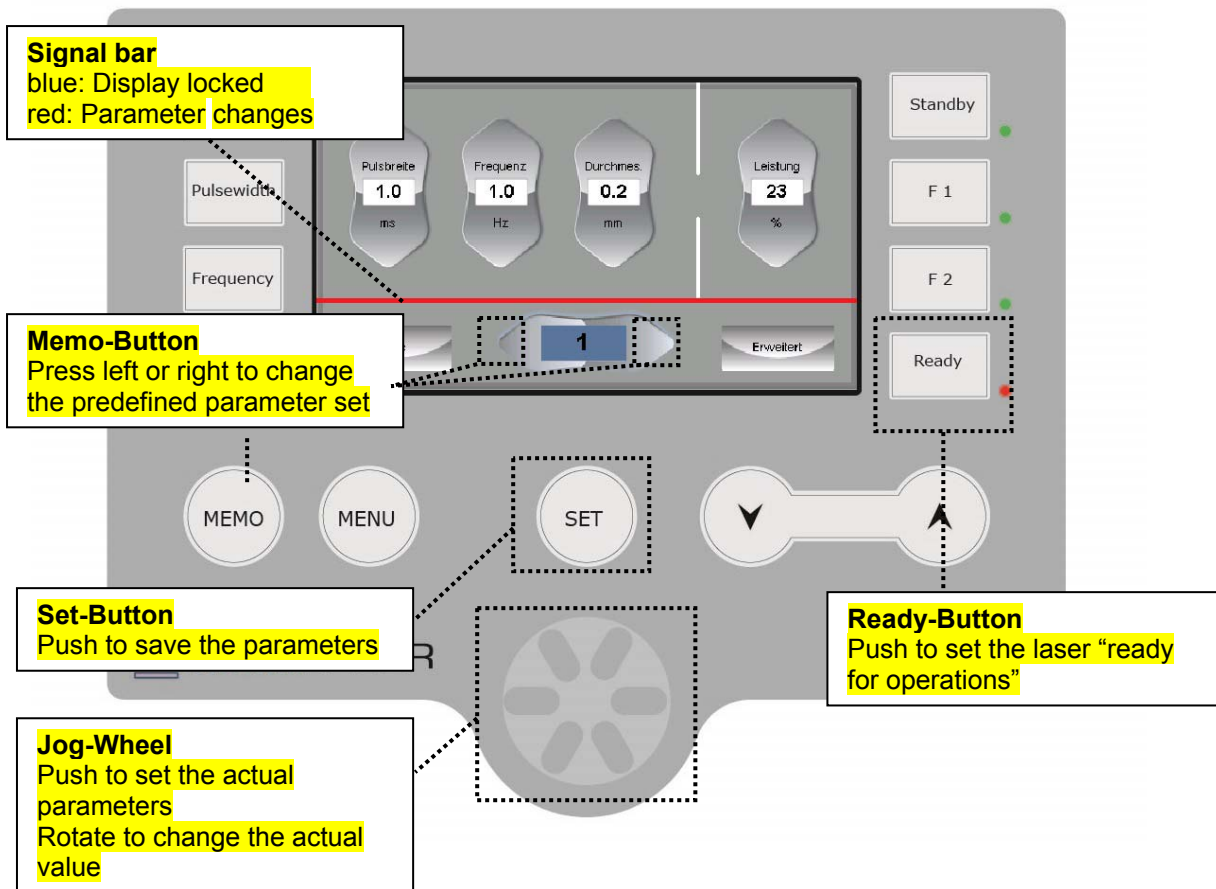
Description of the operation keys are as follows:

| Name | Description |
|-------------|---|
| Standby | Device is on and ready for operation, however pulsing is not possible anymore. |
| Ready | Device is on and ready for operation. Laser pulsing is now possible by actuating the pedal. |
| F1-Button | Perform selected function. See operating settings |
| F2-Button | Perform selected function. See operating settings |
| Power | Regulation of the laser output power. Changes can be done by touch screen, hard buttons or jog-wheel |
| Pulse-Width | Regulation of the laser pulse width. Changes can be done by touch screen, hard buttons or jog-wheel |
| Frequency | Regulation of the laser frequency. Changes can be done by touch screen, hard buttons or jog-wheel |
| Gas | Switch-on/-off of the gas feed valve. |
| Memo | Access to the laser parameter memory. There are 50 storage locations available which are numbered consecutively from 1 to 50. |
| Set | Button for taking over the changed parameters in the current parameter location. |
| Menu | Not in use |
| ▲ ▼ | For changing the current parameter in the cursor. |
| Jog-Wheel | Push for set the adjusted parameters; Rotate to change the current parameter |

Table 3: Description of control keys of the laser beam source

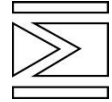


Selection of the predefined (saved) laser parameters

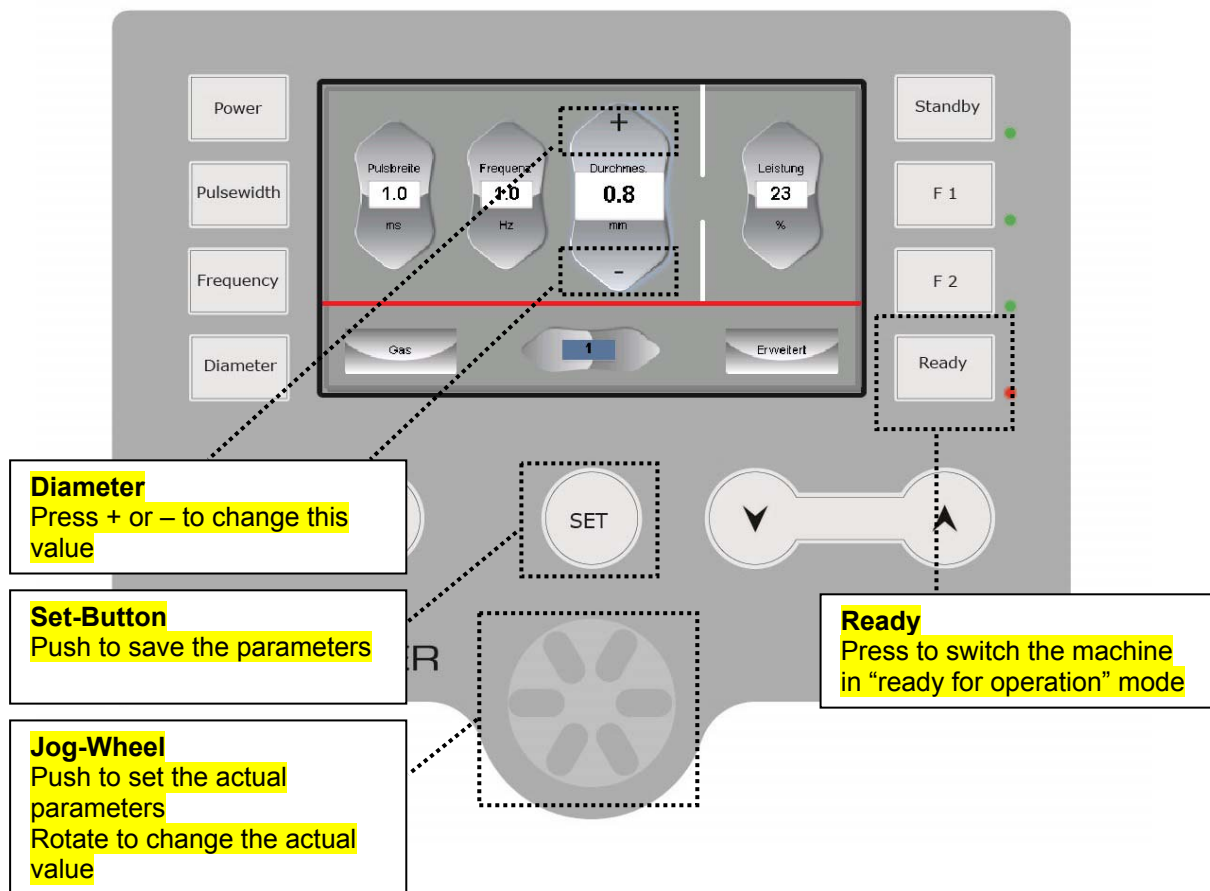


To select and to takeover a predefined parameter set, please proceed as follows:

1. Push the **Memo-Button** on the touch screen.
2. With the buttons ◀▶ you can select the saved and consecutively numbered parameters. You can also use the membrane keys ▲▼ or the Jog-Wheel
3. Press **Set** or press the jog-wheel to takeover the parameters. The modification procedure is running when you see the red signal bar. This can take several seconds while any further inputs are not possible.
4. The process was successful if the signal bar turns from red to blue.
5. Please press the **Ready-button**, to switch the system status in "ready for operation". If the red signal lamp is on the system is ready to pulse.
6. Press the pedal to activate the laser

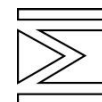


Change of the predefined (saved) laser parameters



Change of a predefined parameter set occurs as follows:

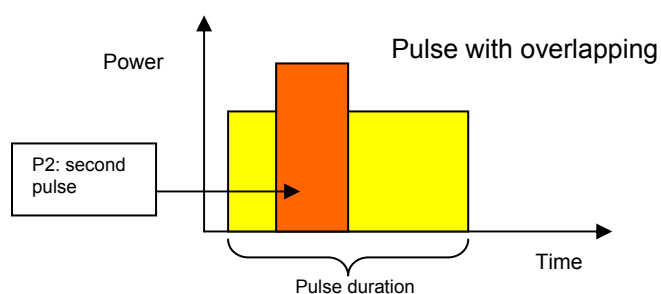
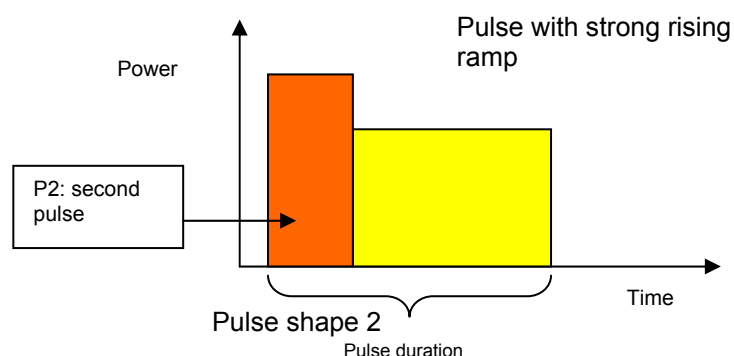
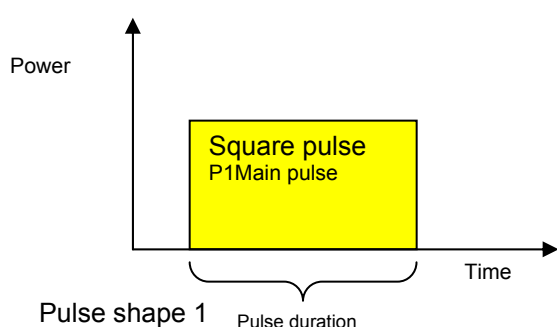
1. Push the **Memo-Button** on the touch screen.
2. With the buttons ▲ ▼ you can select the saved and consecutively numbered parameters
3. To change a parameter such as the focus diameter, press + or – on the touch screen. If the parameter is selected you can also use the rotate function of the jog wheel to adjust the value. Press the jog-wheel to takeover the changing.
4. The process was successful if the signal bar turns from red to blue.
5. Please press the **Ready-button**, to switch the system status in “ready for operation”. If the red signal lamp is on the system is ready to pulse.
6. Press the pedal to activate the laser



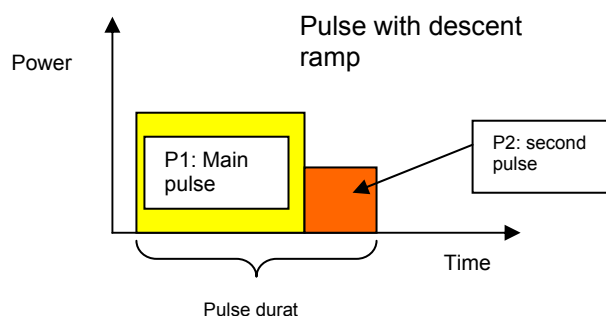
Pulse shaping

This chapter should award some view on the possible applications of pulse shaping. Pulse shaping helps to achieve an advanced weldability of definite materials. The controller of the laser beam source is able to trigger two independent laser pulses. Pulse shaping achieves through overlapping and shift of these two Pulses. In this case you should distinguish between the **main pulse (P1)** and **second pulse (P2)**. A main pulse is the basic power supplier and can trigger relative long pulse duration. Whereas a second pulse is defined for its very short pulse duration and its very high pulse peak power. The second pulse can be activated before, during and after the main pulse. The warm-up and cool-down behavior of base materials can be affected by interaction of these two pulses. In this case it is very important to mention that the effect of pulse shaping is hardly distinguishable for the most of tool steels. You can achieve a better result and weldability for special alloyed materials such as 1.2379, 1.2083 or aluminum alloys by the selection of more proper parameters. The following pulse shapes are due to the two pulses in principal:

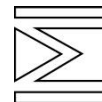
1. Square pulse, second pulse is off (pulse shape 1)
2. Pulse with a strong rising ramp, second pulse is connected backwards (pulse shape 2)
3. Pulse with overlapping (pulse shape 3)
4. Pulse with descent ramp, second pulse is connected afterwards (pulse shape 4)



Pulse shape 3
after the main pulse connected.



Pulse shape 4: Minor pulse is



Pulse shape 1

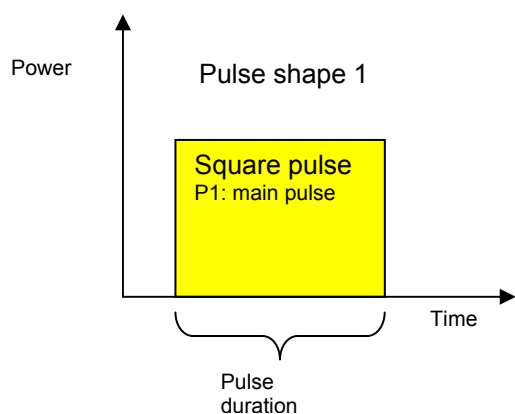
In this pulse shape is the minor pulse off. It is only the main pulse that supplies the necessary power to weld. The minor pulse is off, if **P2:N** applied.

The following examples are some suggestion to understand the issue:

| | | |
|-------------------|-----------------|-------------------------------|
| Base material: | 1.2379 hardened | |
| Wire: | 0, 3 mm | |
| Focus diameter: | 0, 7-0, 8 mm | } power data of main pulse P1 |
| Power P1: | 5 % | |
| Pulse duration: | 10-11 ms | |
| Pulse repetition: | 7-8 Hz | |

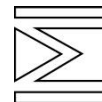
Since P2 is off, the power data of second pulse is not important.

This set of parameter is marked because of its long pulse duration of 11 ms. The controller of the laser is programmed in such a way, that at a long pulse, the power ramp at the end of the pulse decreases and that it takes shape of pulse shape 4. In this way you achieve a continuous and constant cooling of the melting point at the pulse end, whereby the fissuring will be reduced and the weldability improved. With pulse duration of 5 or 6 ms on the contrary you would cool down the base material abruptly at the end of the pulse, thereby boosting fissuring in certain materials.



Caution

These comments are experienced data and fundamental introductions to make it more understandable for the operation personnel. For correctness and testing of these parameters is only the operator responsible.



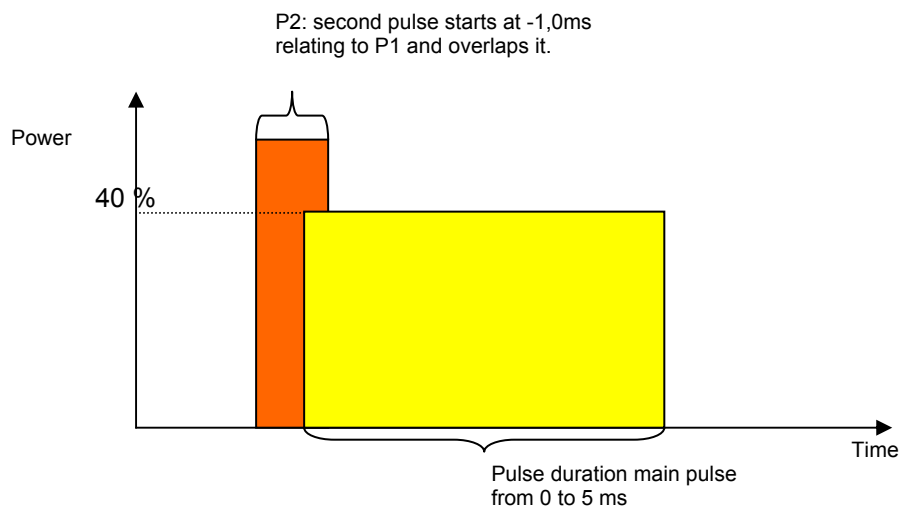
Pulse shape 2

| | | |
|-------------------|--------------|---------------------------------------|
| Base material: | 1.2767 | |
| Wire: | 0, 8 mm | |
| Focus diameter: | 1, 4-1, 5 mm | } Power data of main pulse P1 |
| Power P1: | 40 % | |
| Pulse duration: | 5-6 ms | |
| Pulse repetition: | 2-3 Hz | |
| P2: | Y | } power data of minor pulse P2 |
| Power: | 135 % | |
| Pulse start: | -1, 0 ms | |
| Pulse duration: | 1, 5 ms | |

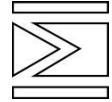
Explanation:

The minor pulse P2 is switched on (Y). The power of P2 with this pulse shape should be always stronger than the power of P1. In this case, the power is 35 % stronger than P1.

The pulse start of P2 lies at -1,0 ms relating to P1 and the pulse duration is 1,5 ms. This means, that P2 begins 1,0 ms before the main pulse and overlaps it 0,5 ms.



These comments are experienced data and fundamental introductions to make it more understandable for the operation personnel. For the correctness, completeness and testing of these parameters is only the operator responsible



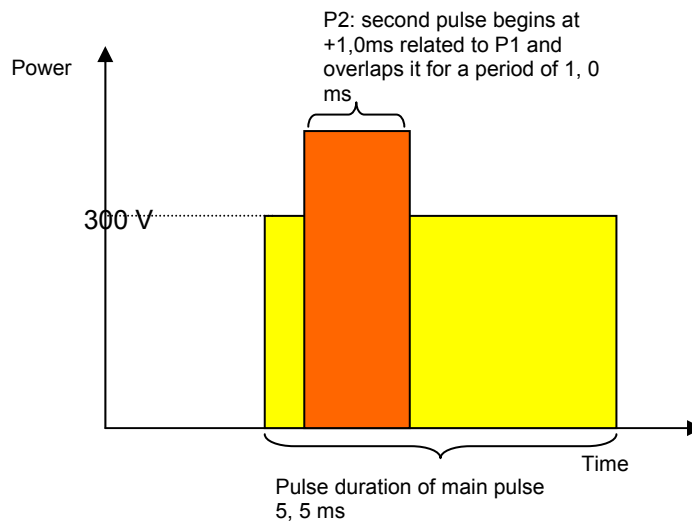
Pulse shape 3

| | | |
|-------------------|--------------|--|
| Base material: | Aluminum | |
| Wire: | 0, 5 mm | |
| Focus diameter: | 1, 1-1, 4 mm | } Power data of main pulse P1 |
| Power P1: | 35 % | |
| Pulse duration: | 5, 5 ms | |
| Pulse repetition: | 3-4 Hz | |
| P2: | Y | } Power data of second pulse P2 |
| Power: | 130 % | |
| Pulse start: | 1, 0 ms | |
| Pulse duration: | 1, 0 ms | |

Explanation:

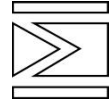
The second pulse P2 is powered up (Y). The power of P2 with this pulse shape should be absolutely stronger than the power of P1. If the power of P2 is less than P1, P2 will be ineffective, because it practically "disappears" in P1.

The pulse start of P2 lies at +1, 0 ms related to P1 and the pulse duration amounts 1, 0 ms. It means that P2 begins about 1, 0 ms after the main pulse and overlaps it for a period of 1, 0 ms.



Caution

These comments are experienced data and fundamental introductions to make it more understandable for the operation personnel. For correctness and testing of these parameters is only the operator responsible.



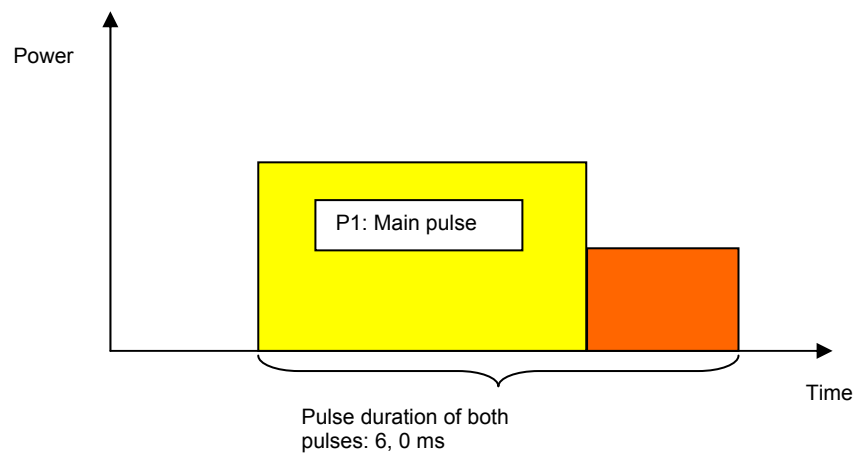
Pulse shape 4

| | | |
|-------------------|--------------|--|
| Base material: | 1.2343 | |
| Wire: | 0, 8 mm | |
| Focus diameter: | 1, 4-1, 7 mm | } Power data of Mail pulse P1 |
| Power P1: | 45 % | |
| Pulse duration: | 4, 0 ms | |
| Pulse repetition: | 3-4 Hz | |
| P2: | Y | } Power data of second pulse P2 |
| Power: | 78% % | |
| Pulse start: | 4, 0 ms | |
| Pulse duration: | 2, 0 ms | |

Explanation:

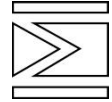
The second pulse P2 is on (Y). The power of P2 should be absolutely less than the power of P1 in this kind of pulse shaping.

The pulse start of P2 lies at +4, 0 ms related to P1 and the pulse duration is 2, 0 ms. It means that P2 begins after the main pulse and continues 2, 0 ms, thereby it results the total pulse length of 6, 0 ms.

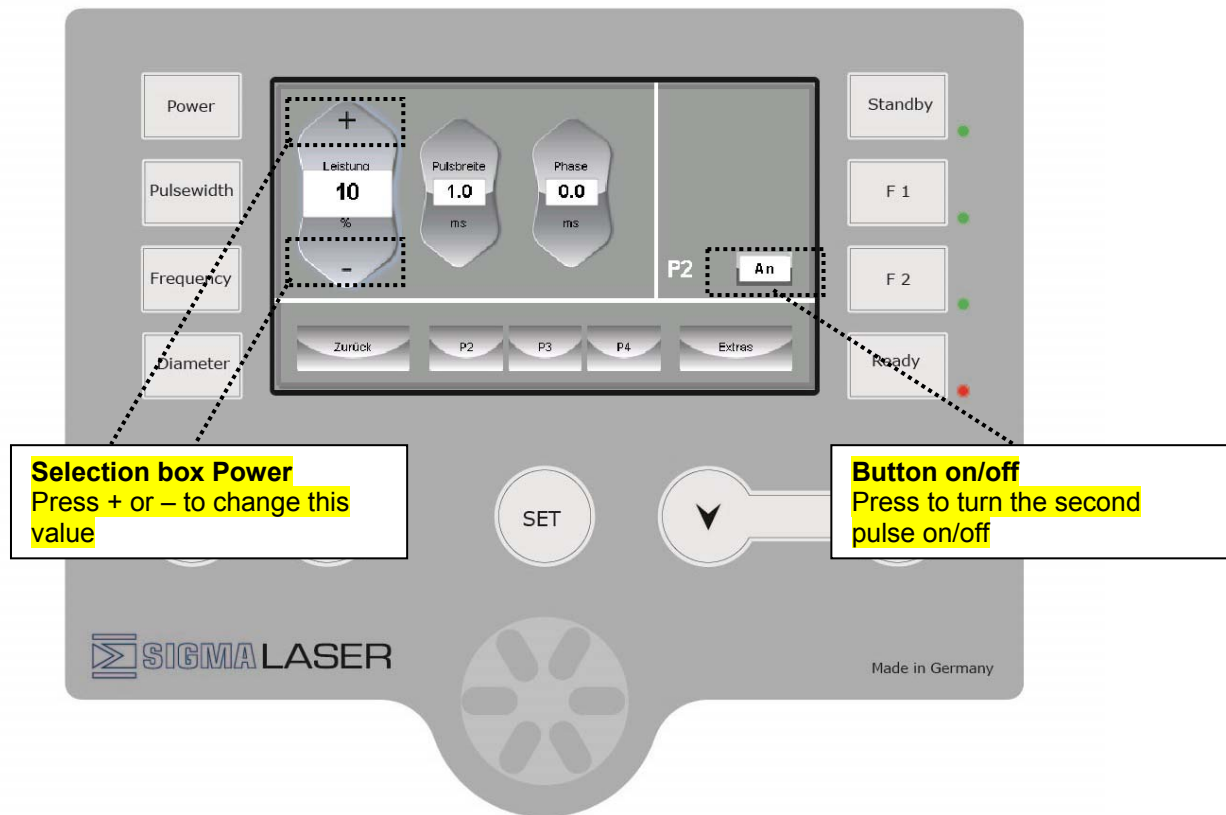


Caution

These comments are experienced data and fundamental introductions to make it more understandable for the operation personnel. For correctness and testing of these parameters is only the operator responsible.

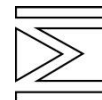


Change of the predefined (saved) laser parameters for the second pulse



Change of a predefined parameter set for the second pulse occurs as follows:

1. Press the **Memo Button** to change over to the main menu
2. With the buttons **▲ ▼** you can select the saved and consecutively numbered parameter sets.
3. Adjust the parameters of the main pulse just as described in the previous chapter
4. Press the **“extended” Button** in the right corner of the main menu to get to the second pulse menu.
5. Press the **On/Off Button** on the right side of the screen to turn the second pulse on or off
6. Choose one of the parameter selection fields (power, pulse width , phase)
7. To change a parameter press **+ or –** on the touch screen. If the parameter is selected you can also use the rotate function of the jog wheel to adjust the value. Press the jog-wheel to takeover the changing.
8. The process was successful if the signal bar turns from red to blue.
9. Press the **Set Button or the Jog-Wheel**, to save the changes
10. Press the **Ready-button**, to switch the system status in “ready for operation”. If the red signal lamp is on the system is ready to pulse.
11. Press the pedal to activate the laser



Extras

In the “second pulse” menu you will find the “extra” Button. Pressing this will guide you to the operational information site but also to the programming settings for the automatically axes movement.

Operational information - Error

This site shows a tabular list of the last registered errors. To scroll between the single entries press the ▲ ▼ Buttons.

Operational information - Monitor

This site shows a tabular list of the systems control signals. To scroll between the single entries press the ▲ ▼ Buttons.

Please bear in mind that the list contains status information but also temporally test results. So a red status symbol doesn't mean there is necessarily a system error.

You will find more details in the attachment or our from support team +49 (0) 6171-206 167-0.

Operational information – Running time

You can see the following operating data:

| Name | Description |
|----------------|--|
| Uptime | It shows the current stand Operating hour with seconds counter. |
| Session | Number of sessions. It shows that how often the laser beam source was switched on and off. |
| Operating time | Shows the time since the last turn-on |
| Discharging | Number of pulses which has been disengaged during the discharge process. |

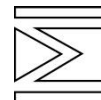
Table 4: Description of the elements of the operating data

Operational information – Settings

This site shows the system settings, the settings for the user interface as well as the settings for the axes movement. See chapter control signals. To scroll between the single entries press the ▲ ▼ Buttons. To change a value use the + or – Button. All changes will be saved. A change of the system language will be executed after you leave this menu site.

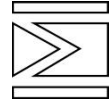
Attention: All changes to the axes speed or acceleration should only be done by **technically versed persons**.

Wrong settings can result in heavy vibrations of the system.



| Name | Description |
|----------------------|---|
| Gas delay | Setting for the gas delay or forerun, value in milliseconds |
| Soft-Start | Switch on/off the Soft-Start-Function. This is used to prevent the first pulses from an excessive increase of power |
| Lens type | Setting for the lens of the system (focal length 100, 150, 200 or 300 mm) |
| Language | Language of the user interface (englisch/german) |
| Button F1 | Button can be configured by the user |
| Button F2 | Button can be configured by the user |
| Contrast | Contrast of the touch screen display. Value between 0 and 255. Only on 10" display. |
| Brightness | Brightness of the touch screen display. Value between 0 and 10. |
| X-axis | Switch on/off the X-axis |
| Y-axis | Switch on/off the Y-axis |
| Automatic laser | Turn on the laser by deflection of the joystick. React to: <ul style="list-style-type: none"> - no axes - XY-axes - Z-axis - both |
| Puls-synchronisation | Not yet implemented |

Table 6: Description of the operating settings



Operational setting – factory setting

With this button the system will be set back to the factory settings. This includes the basic settings but also the parameter sets (memos). Confirm the following dialog with „yes“.

Operational information – Pulse shaping diagnosis

By pressing the **Pulse Button** you will obtain an overview above the optical characteristics of the currently set memo (pulse energy, pulse width, peak- and average power). Please bear in mind that all this entries are approximated values that can deviate from the actual parameters caused by the transmission effect.

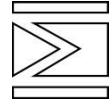
Automatic funtions

In the standard version of this system there are six automatic programmes included. This will provide the user when working manually with the machine. Please keep in mind that these are rudimentary programmes that can't replace a fully operational CNC-Software.

Every program can be executed in two different operation modes. In the semi-automatic modus (M) the user can change the speed and direction of the program by deflecting the joystick and start the laser by pressing the pedal. In the fully automatic mode (A) the system will take over the control of the axes movement and the laser function. The precondition for this mode is also the "Ready for operation"-status, that has to be switched on from the user on the right site of the display.

Please be aware that the automatic program will not start until all necessary settings (position data, ready status and so on) are entered in the system. A change while is system is running isn't possible due to safety reasons.

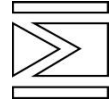
The user is responsible for the proper use of the automatic function.



Automatic program – Line

The automatic programm Line allows you, to drive a simple Line between two Points respectively or to measure.

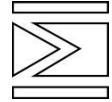
1. Go to point P1 and actuate the Button Set on the touch screen or the Button Pos1 on the Joystick.
2. Go to point P2 and actuate the Button Set on the touch screen or the Button Pos2 on the Joystick
3. The positioning field in the third line shows the distance between point 1 and point 2 based on the coordinates of XYZ
4. Chose the operation mode by pressing the button → in the right bottom corner. Hold the button for 2 seconds.
5. In the event of the fully automatic operation (A) adjust the speed in percent on the Joystick.
6. Actuate the Button ►■ to start the program. Alternative you can press the Button Start at the Joystick. The signal light at the Joystick signalled a running automatic program.
7. In the event of the half automatic operation steer the Joystick in x direction. Start the Laser upon need by pressing the pedals. At the end of the repetition actuate the Button >> in the lower bar, to begin the next repetition.
In the event of full automatic operation the system begins by reaching P1 and start the Laser there.
8. You can abort the program at any time by pressing the Button ►■ on the touch screen or the Button Start on the Joystick.



Automatikfunktionen – Polylinie

The automatic program Poly line allows you, to drive a multiple line with up to twenty points. You have further the option to repeat the complete profile with a constant displacement. This option is aimed at user, which want to perform surface fillings.

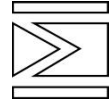
1. Go to each point of the desired profile and actuate respectively the Button Set on the touch screen or the Button Pos1 on the Joystick. The position counter in the first row increase automatically after every memory process by one. By the Buttons <<and>> do you have the opportunity, to change Positions later.
2. In the second line , the number of desired repeats can be adjusted by repeatedly pressing the Button Plus/Minus.
3. In the third row the desired shift per repeat is set. Select the desired coordinate by repeatedly pressing the coordinates field.
4. Change the displacement of the coordinate by actuate the Button Plus/Minus.
5. Choose the wished operation mode by pressing the Button → in the lower right corner. Hold the Button at least for 2 seconds.
6. In the event of the fully automatic operation (A) adjust the speed in percent on the Joystick.
7. Actuate the Button ►■ to start the program. Alternative you can press the Button Start at the Joystick. The signal light at the Joystick signalled a running automatic program.
8. In the event of the half automatic operation steer the Joystick in the x direction. Start the Laser upon need by pressing the pedals. At the end of the repetition actuate the Button >> in the lower bar, to begin the next repetition
In the event of full automatic operation the System begins by reaching P1 and start the Laser there. The Laser stops at the end of the profile and then moves to the next repetition.
9. You can abort the program at any time by pressing the Button ►■ on the touch screen or the Button Start on the Joystick.



Automatic function – Circle

The automatic program circle allows you, to drive a simple circle based on two points (starting point and center point).

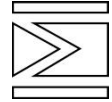
1. Go to the starting point of the circle and actuate the Button Set on the touch screen or the Button Pos1 on the Joystick.
2. Go to the Focus P2 and actuate the Button Set on the Touchscreen or the Button Pos2 on the Joystick.
3. Choose the wished operation mode by pressing the Button → in the lower right corner. Hold the Button at least for 2 seconds.
4. In the event of the fully automatic operation (A) adjust the speed in percent on the Joystick.
5. Actuate the Button ►■ to start the program. Alternative you can press the Button Start at the Joystick. The signal light at the Joystick signalled a running automatic program.
6. In the event of the half automatic operation steer the Joystick in x direction. Start the Laser upon need by pressing the pedals. In the event of full automatic operation the system begins by reaching P1 and will start the Laser there.
7. You can abort the program at any time by pressing the Button ►■ on the touch screen or the Button Start on the Joystick.



Automatic function – Polycircle

The automatic program Poly circle allows you, to drive a circle on the basis of the three point definition. All three points have to be on the circle. You have further the option to repeat the complete Profil with increasing radius. This option is aimed at user, which want to carry annular surface fillings.

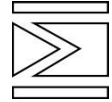
1. Go to three points of the desired circle and actuate respectively the Button Set on the Touch screen or the Button Pos1 on the Joystick. The position counter in the first row increases by one automatically after every memory process. With the Buttons << and >> you have the opportunity, to change positions later.
In the second row the desired shift per repeat is set. Change the displacement of the radius by actuate the Button Plus/Minus.
2. In the second line the number of desired repeats can be adjusted by repeatedly pressing the Button Plus. Ten repeats are maximum.
3. Choose the wished operation mode by pressing the Button → in the lower right corner. Hold the Button at least for 2 seconds.
4. In the event of the fully automatic operation (A) adjust the speed in percent on the Joystick.
5. Actuate the Button ►■ to start the program. Alternative you can press the Button Start at the Joystick. The signal light at the Joystick signalled a running automatic program.
In the event of the half automatic operation steer the Joystick in the x direction. Start the Laser upon need by pressing the pedals. At the end of the repetition actuate the Button >> in the lower bar, to begin the next repetition. In the event of full automatic operation the System begins by reaching P1 and start the laser there. The Laser stops at the end of the profile and then moves to the next repetition.
6. You can abort the program at any time by pressing the Button ►■ on the touch screen or the Button Start on the Joystick.



Automatic function – Arc

The automatic programm arc allows you, to drive a Bezier-curve on the base of the three point definition. Point one and three form start and end point. Point two is so-called checkpoint, this determines the curvature of the curve. This program has no backwards option.

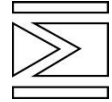
1. Go to every point of the desired profile and actuate then the Button Set on the touch screen or the Button Pos1 on the Joystick.
2. Choose the wished operation mode by pressing the Button → in the lower right corner. Hold the Button at least for 2 seconds.
3. In the event of the fully automatic operation (A) adjust the speed in percent on the Joystick.
4. Actuate the Button ►■ to start the program. Alternative you can press the Button Start at the Joystick. The signal light at the Joystick signaled a running automatic program.
5. In the event of the half automatic operation steer the Joystick in x direction. Start the Laser upon need by pressing the pedals.
In the event of full automatic operation the System begins by reaching P1 and start the laser there. The Laser stops at the end of the profile.
6. You can abort the program at any time by pressing the Button ►■ on the touch screen or the Button Start on the Joystick.



Automatic function – Spline

The automatic program Spline allows you, to drive a curve with up to ten checkpoints. Every checkpoint needs to be on the curve. The System optimizes the guide way to a smooth curve. Should the curve not match with the desired guide way, it is recommended to increase the density of the checkpoints in the affected areas.

1. Go to every point of the desired profile and actuate the Button Set on the touch screen or the Button Pos1 on the Joystick. The position counter in the first row increases automatically after every memory process by one. By the Buttons << and >> you have the opportunity, to change positions later.
2. Choose the wished operation mode by pressing the Button → in the lower right corner. Hold the Button at least for 2 seconds.
3. In the event of the fully automatic operation (A) adjust the speed in percent on the Joystick.
4. Actuate the Button ►■ to start the program. Alternative you can press the Button Start at the Joystick. The signal light at the Joystick signaled a running automatic program.
5. In the event of the half automatic operation steer the Joystick in the x direction. Start the Laser upon need by pressing the pedals.
In the event of full automatic operation the System begins by reaching P1 and start the Laser there.
6. You can abort the program at any time by pressing the **Button ►■** on the touch screen or the Start button on the joystick.

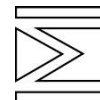


Automatic function – Tend

With the Button Tend you can adjust the axes of your System to a appropriate working level. This process is also known as coordination transformation.

1. Go to the origin of the desired coordination systems and actuate the Button Set next to P0.
2. Go to any point on the wished X-Axis and actuate the Button Set next to PX..
3. Go to any point on the wished Y-Axis and actuate the Button Set next to PY.
4. Press the Button ON/Off next to the Symbol Y->X, to align the Y-Axis vertically at the X-Axis.
5. Press the Button On/Off next to the Symbol Chop, to activate the coordination transformation

The new X-Axis corresponds to the connecting line between P0 and PX. The new Y-Axis corresponds to the connecting line between P0 and Py. The Z-Axis becomes automatically perpendicular calculated to this axis.



Switching off of laser system

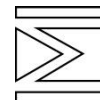
Switching off the system occurs in the following order:

1. Switch off the laser beam source with the main switch (see picture 1 pos.2)



Caution

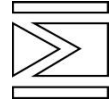
To avoid damage to the laser beam source, never switch the system off with the emergency stop button!



Malfunction and Fault Messages

It appears a fault message with an error code in the display of laser beam source in the case of a malfunction.

| Message | Description | Clarification |
|-------------------|-----------------------------------|--|
| System Overheat | Operating temperature is too high | Wait a few minutes and check the level of cooling water, if it occurs repeatedly. Please contact the service technician, if these messages appear frequently. |
| System Error 40 | Laser shutter – closed position | An internal check of the laser shutter reported an error. Loose the pedal and start again. |
| System Error 41 | Laser shutter – exposure | An internal check of the laser shutter reported an error. Loose the pedal and start again. |
| System Error 50 | Beam expander | Recommendation of the beam expansion (diameter of the weld spot) is not correct. |
| System Error 51 | Beam expander | Recommendation of the beam expansion (diameter of the weld spot) is not correct. |
| System Error 60 | Microscope shutter | LCD-Shutter under the microscope is not opened correctly – Switch it off and switch it on after ca. 30 seconds again – Surrounding temperature should not be under 5°C. |
| System Error 70 | Water Pump | Check the water throughput – Control the contact of the flow rate sensor – Avoid to switch on and off of the laser system rapidly (ca. 20 sec. pause between switching off and on) - The tube package between the resonator and laser steering is probably deformed. |
| System Error 81 | Simmer lamp 1 | Voltage on laser lamp 1 not correct – check laser lamp and replace it, if necessary - |
| System Error 82 | Simmer lamp 2 | Voltage on laser lamp 2 not correct – check laser lamp and replace it, if necessary - |
| System Error 83 | Simmer lamp 1 and 2 | Voltage on laser lamp 1 and 2 not correct – check laser lamp and contact service technician |
| Attach Footswitch | Attach foot pedal | The Foot pedal is not attached. It might be that the contacts of the micro switches in the foot pedal have to be readjusted. |



Maintenance

Change of the safety glass

It is recommended to clean the safety glass regularly, **every hour** during the operation. To do this, use dry or in acetone soaked tissues.



Picture 6: Damaged lens. This can be prevented by regular controlling of the safety glass.

If you notice that the safety glass is damaged, change it immediately. In such a case, please do as follows:

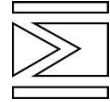
1. Remove the cover of the lens.
2. Pick out the safety glass carefully. **Do not touch the lens.**
3. Place the new safety glass into the capping.
4. Close the capping carefully, so that the safety glass pushes the lens slightly and is held there.



Danger



Wear protective glasses and protective gloves!

Remove glass fragments carefully!



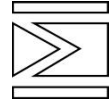
Changing the flash lamp

To avoid damage to the laser processing station or dangerous injuries during maintenance, the following points must absolutely be observed:

| | |
|--|--|
|  <p>Caution</p> | <p>Read and observe the instructions on the work completely!</p> <p>Perform all working steps in the specified order!</p> <p>If in doubt, always ask!</p> <p>Check all work performed before switching back on!</p> <p>Perform all work on the optical components when you are composed and concentrated!</p> <p>Work extremely carefully - risk of destroying the optical elements!</p> <p>Document all maintenance work</p> |
|  <p>Danger</p> | <p>Maintenance work may ONLY be performed by properly trained specialists!</p> <p>Observe accident protection regulations BGV A 1, BGV A 2 and BGV B2!</p> <p>Observe safety measures for work on laser equipment and life-threatening high voltage!</p> |

Wrong or bad outworking of the instruction manual results in losing the warranty.

The manufacturer accepts **no liability** for improperly performed maintenance work or for any damages that result from it!



Remove dust from resonator housing 1 with dry cloth or wipe with a moist cloth and soapy water.



Never use solvents or alcohol!

1. Switch device off, separate it from the power network, and secure it against unintentional switching back on
2. Wait at least 15 minutes
3. Prepare a clean placement surface, preferably paper towels **or use a sponge**
4. Remove **external** cover of the resonator and place it on the clean placement surface
5. Remove **internal** cover of the resonator and place it on the clean placement surface

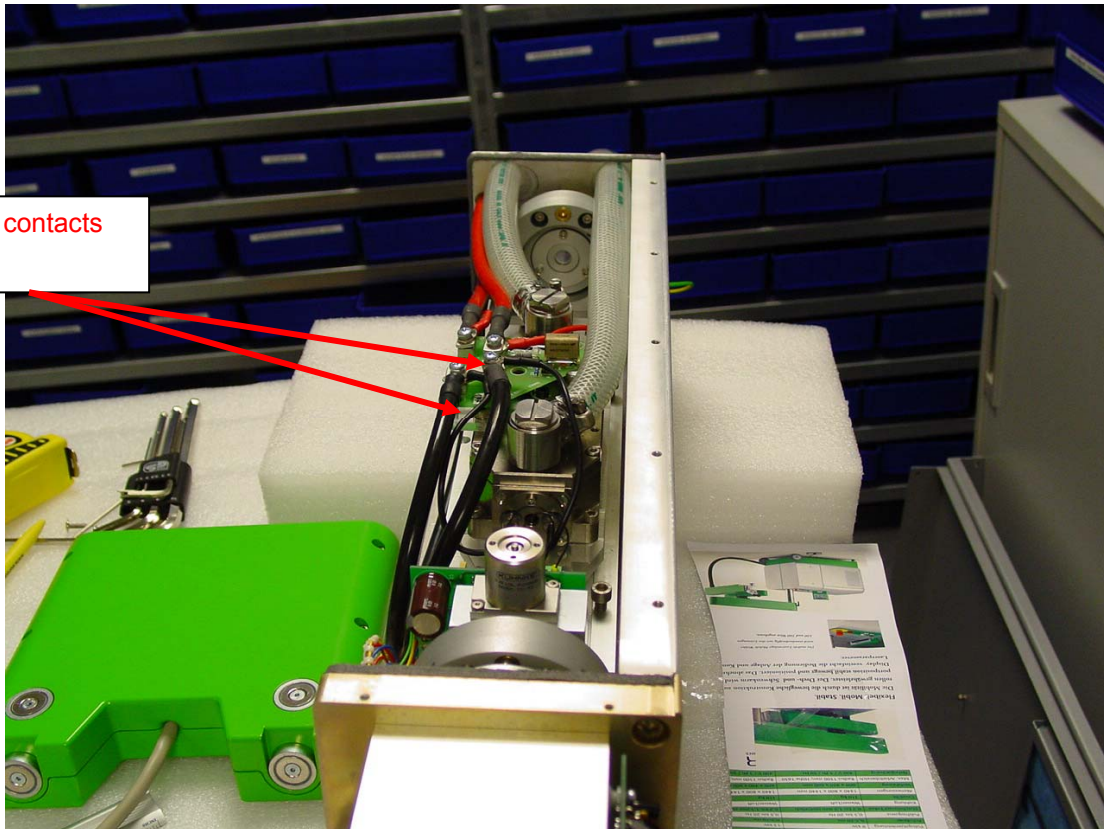


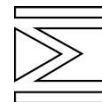
Wear protective glasses and protective gloves!

The pump flashes are under high pressure - risk of explosion!

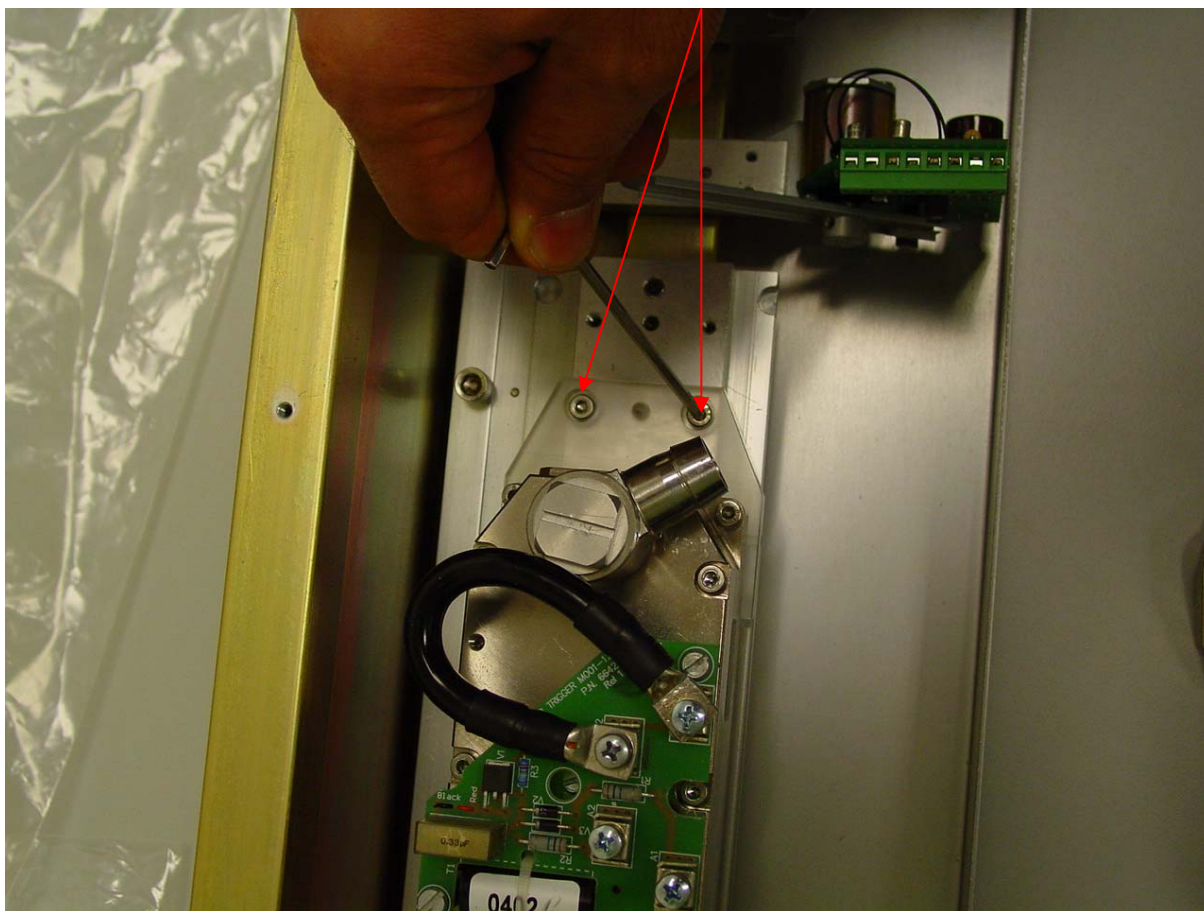
6. **check the voltage at the lamp contacts before operating**

Lamp contacts

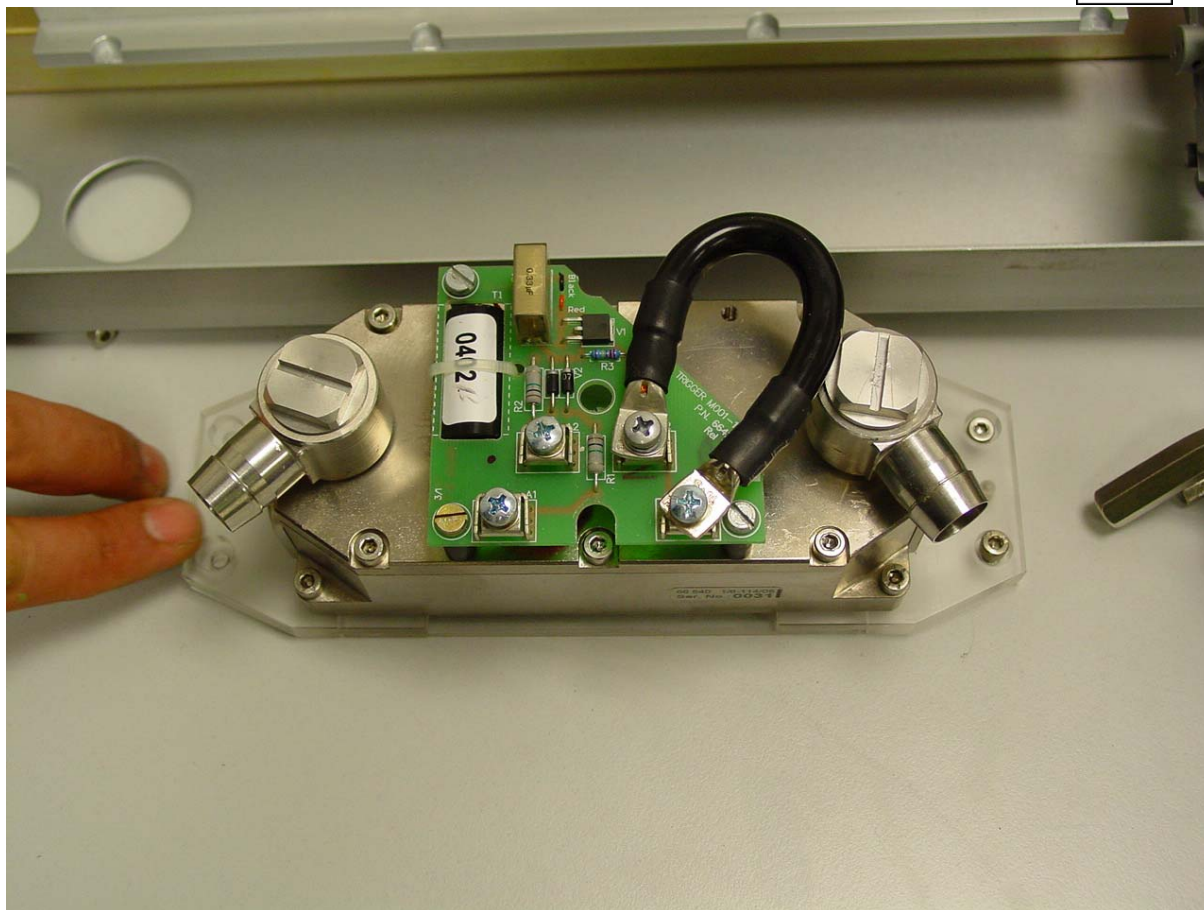
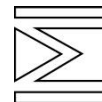




7. Avoid to move or to touch of the mirrors or the electronic system.
8. Unscrew the only hexagonal screw shown in the picture.
9. Separate the cooling hoses carefully, so that water can not issue from the resonator as possible.
10. In this case hold the hoses up and let the water flow in a jar.
11. Disconnect the red and the black wire carefully from the electronic board. **Regard thereby the marking of the wires**, so that they will be connected to the same pad later. Make your own marking in a case of need.
12. Open the 4 hexagonal screws carefully as shown in the picture below.

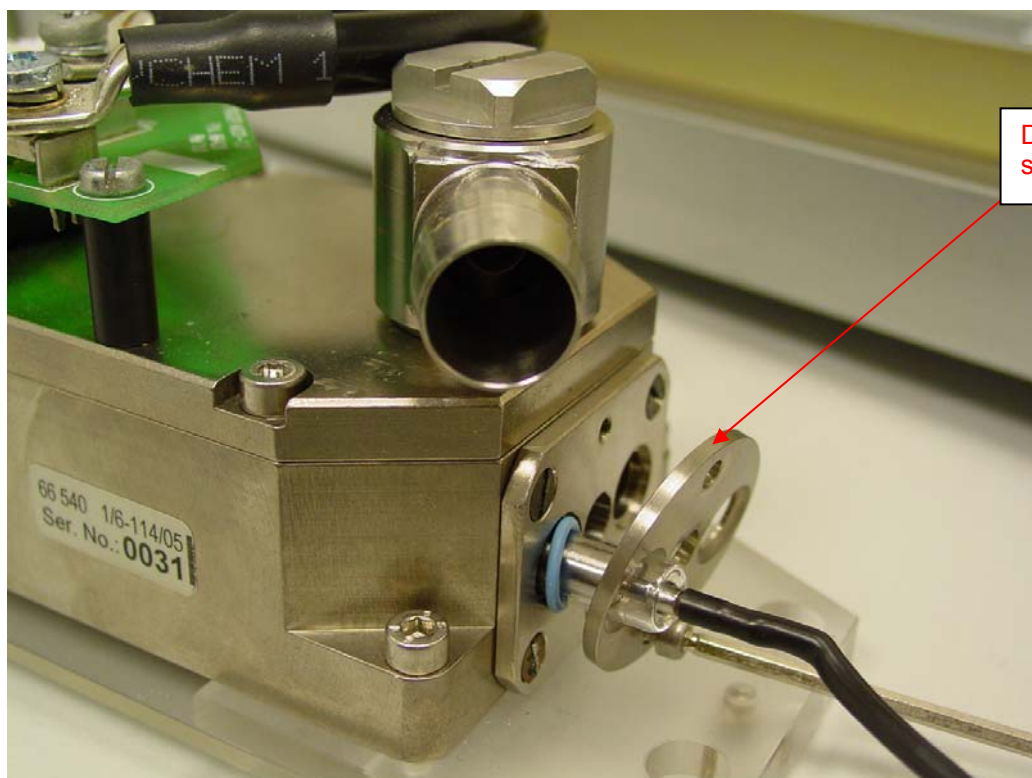


13. Take the cavity out of the holder and place it on a clean surface.

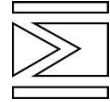


The laser lamps are attached with a sealing plate and one o-ring a time.

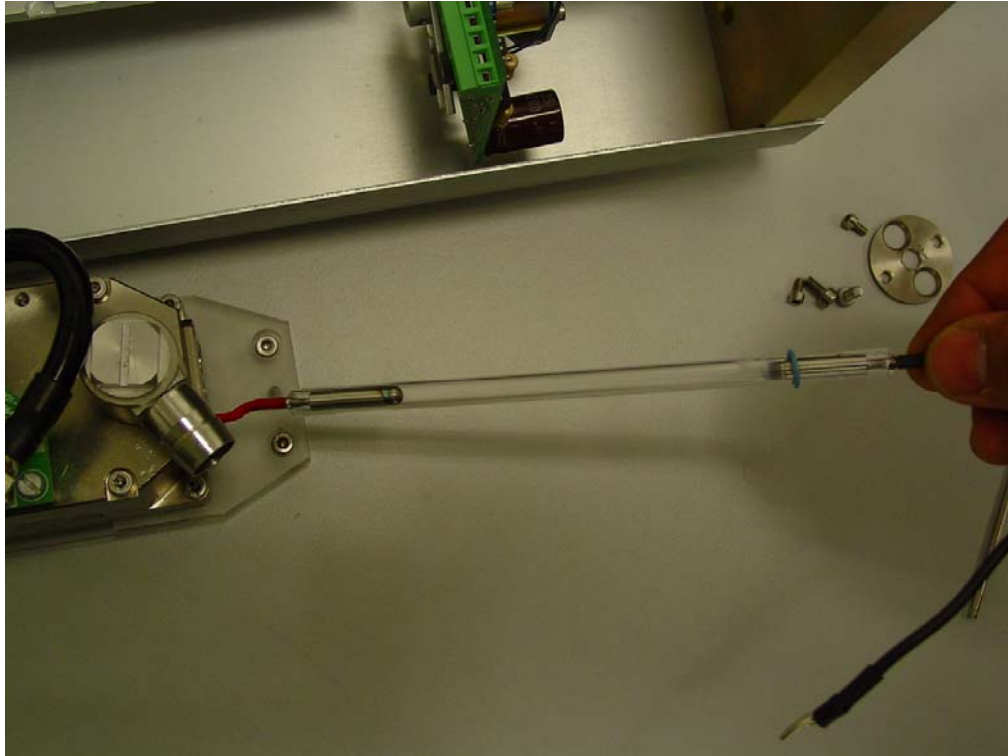
14. Disengage carefully the screw joint of this **sealing plate on both sides**



Disengage
sealing plate



15. Be sure that the lamp is detached from both sides and try to pick it out by no force, if possible
16. Put the covering and the o-ring on a clean surface
17. Pull out the laser lamp **carefully**



18. Insert the lamp accordingly in the respective hole again. To do this, please only touch the lamp at the contacts.



Caution

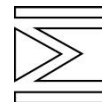
**Only touch the flash contact with clean paper.
Only touch the flash at the contacts.**

19. Raise the o-rings from both sides.



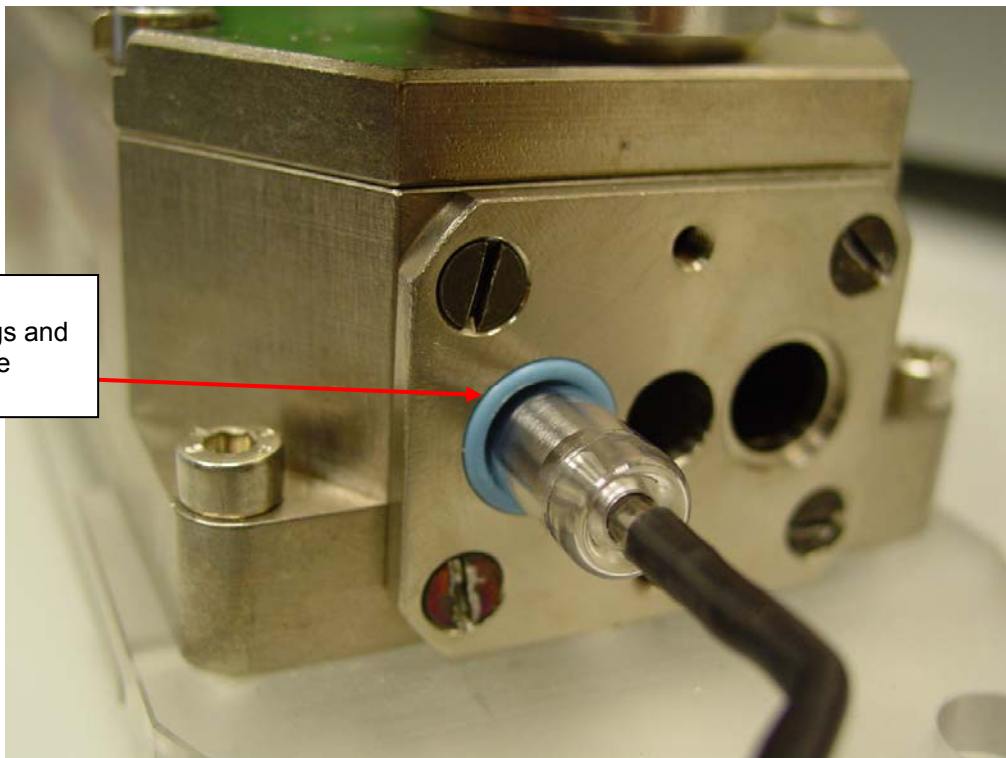
Caution

Note the polarity of the flash! – The contacts are marked in (black / red).



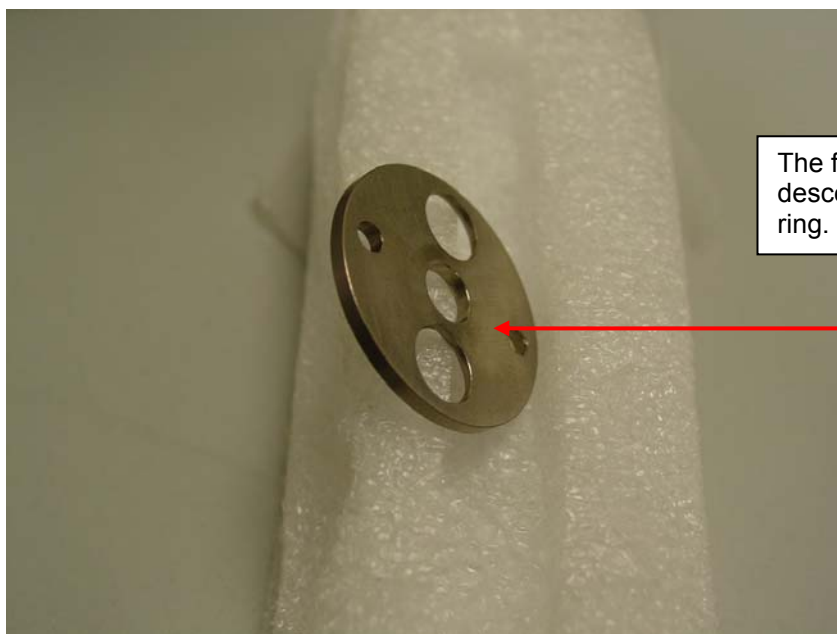
20. Please pay attention that the o-rings are located accurately.

Attention to the position of o-rings and the polarity of the lamp!



21. Insert the lamp centrally so that both ends seem equally, if possible.

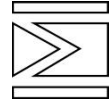
22. Fit the sealing plate so that the flat side lies on the o-ring.




The flat side (without descent) lies on the o-ring.

23. Screw the sealing plate slowly but not **tightly**.


24. Pay attention to the position of the lamp. It must seem uniformly out of the cavity.



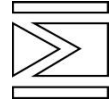
25. The lamp will be displaced slightly because of adduction of the sealing plate. Correct this adjustment carefully and **pull the sealing plate tightly and uniformly over both sides.**
26. Check, if the o-rings are correctly located.
27. Insert the cavity again. To do this, please pay attention to the **locating pins** which are under the **Plexiglas plate**. They must be put exactly in the intended position.
28. Joint the cavity with 4 hexagonal screws to the **Al-plate**.
29. First of all joint the water hoses. Pay attention that no water escapes absolutely
30. Joint the cable according to the marking so that you have a correct contact as a result.
31. Check the contacts between circuit board and cabling again.
32. Dry water drops in the resonator, if necessary. **To do this, please avoid any kind of contact to the mirror holders!**
33. Use a hair dryer in case of need but **no compressed-air pistol!**
34. Switch on the device.

| | |
|--|---|
|  Danger | <p>Wear suitable laser protection glasses! - Laser radiation is emitted</p> <p>High voltage at the lamp contacts!</p> |
|--|---|

35. Check again the o-rings and the hoses to be watertight.
36. Screw the capping of the resonator together

| | |
|---|---|
|  Caution | <p>Check all plug connections, coverings, and seals for good connection.</p> |
|---|---|

If System Error 70 ought to appear after the power-up, pour deionised water in the cooling system (see next section).



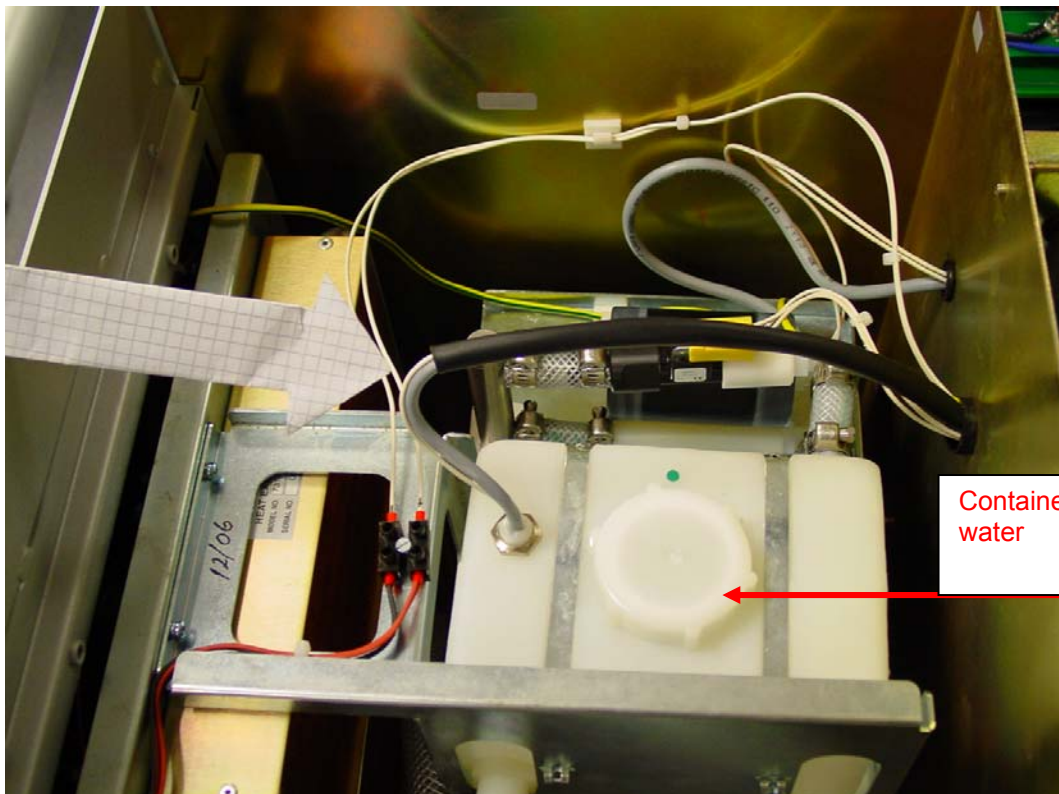
Cooling system

Filling of the container

The laser device is cooled by a water-air-cooling system and **deionised water**. The error report, System Error 70 indicates low water.

The water should be changed **once a year**.

1. Shut off the device, disconnect it from the mains and secure it against unintentional power-up
2. First take the covering off
3. Open the plastic cover of the case up
4. Fill some deionised water and switch on the device.
5. To ventilate it, leave the plastic cover open for some seconds.
6. Close the cover.

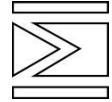


Danger

Maintenance work should ONLY be carried out by appropriate trained technical staff!

Consider the accident prevention regulations **BGV A 1, **BGV A 2** und **BGV B 2**!**

Consider the safety measures to work at **Laser-Equipment and with extremely dangerous high voltages absolutely!**

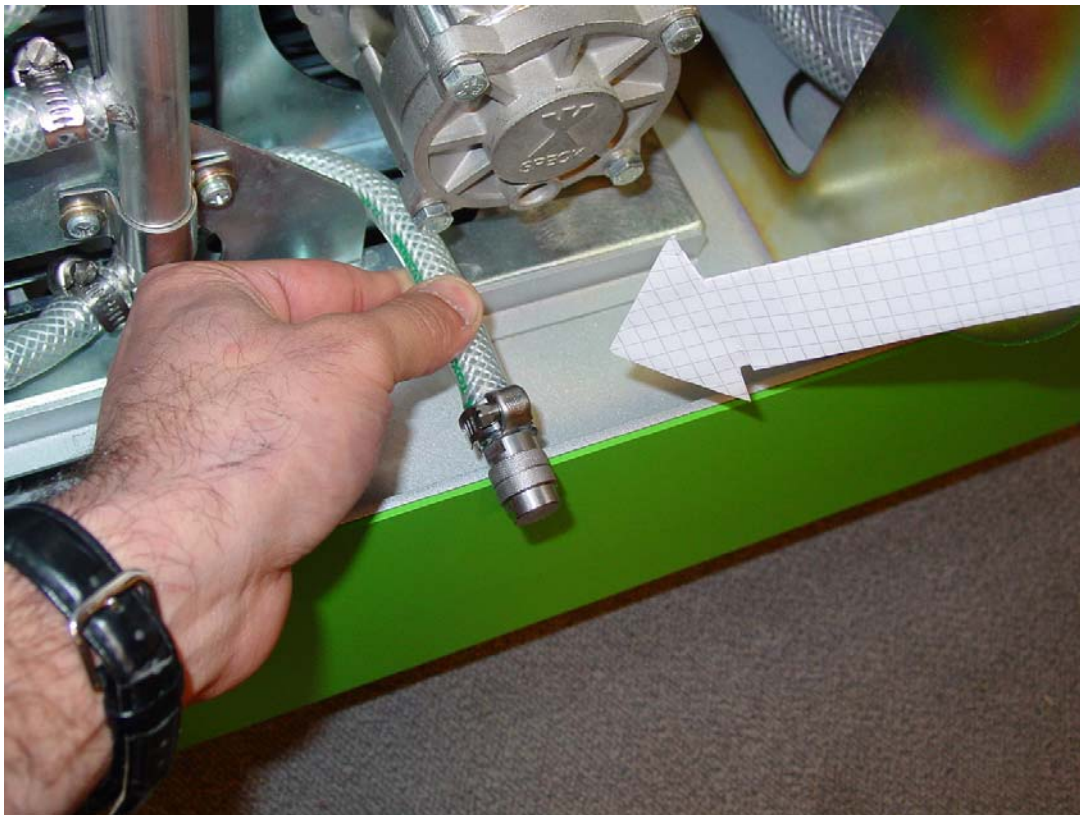


Water exchange and draining

The water should be refreshed **once a year**.

An appropriate opening is available to drain the cooling system.

1. Switch off the device, separate it from the power network, and secure it against unintentional Power-up
2. Remove firstly the covering.
3. Open the plastic cover of the case.
4. Open the screw joint at the end of hose (See Picture).



The cooling system will be emptied now. For filling the laser device, see last section

See also Chapter 2 "General safety information".